

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 16 August 2000 (16.08.00)	
International application No. PCT/ES99/00381	Applicant's or agent's file reference 199.222/MAD
International filing date (day/month/year) 24 November 1999 (24.11.99)	Priority date (day/month/year) 28 November 1998 (28.11.98)
Applicant DIAZ CARMENA, Francisco et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
28 June 2000 (28.06.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Olivia RANAIVOJAONA Telephone No.: (41-22) 338.83.38
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JC Rec'd PCT/PTO 2 5 MAY 2001

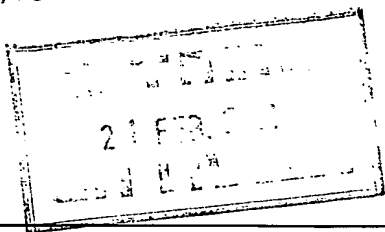
**COMPLETE TEXT INCLUDING ALL THE AMENDMENTS
MADE DURING INTERNATIONAL PHASE**

PATENT COOPERATION TREATY

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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ESPAGNE



PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing
(day/month/year) 19.02.2001

Applicant's or agent's file reference
199.222/MAD

IMPORTANT NOTIFICATION

International application No.
PCT/ES99/00381

International filing date (day/month/year)
24/11/1999

Priority date (day/month/year)
28/11/1998

Applicant
SOCIEDAD ESPAÑOLA DE ELECTROMEDICINA ... et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference 199.222/MAD	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/ES99/00381	International filing date (day/month/year) 24/11/1999	Priority date (day/month/year) 28/11/1998
International Patent Classification (IPC) or national classification and IPC B62B5/00		
Applicant SOCIEDAD ESPAÑOLA DE ELECTROMEDICINA ... et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 6 sheets, including this cover sheet.
 - ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 17 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 28/06/2000	Date of completion of this report 19.02.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Fuchs, A Telephone No. +49 89 2399 2987 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/ES99/00381

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-9 as received on 28/11/2000 with letter of 24/11/2000

Claims, No.:

1-8 as received on 28/11/2000 with letter of 24/11/2000

Drawings, sheets:

1/4-4/4 as received on 28/11/2000 with letter of 24/11/2000

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/ES99/00381

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-8
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-8
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-8
	No:	Claims	

2. Citations and explanations see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

Re Item VIII

Certain observations on the international application

The present application does not meet the requirements of Article 6 PCT, because the subject-matter of the invention is unclear. The reasons are given hereafter.

1. The subject-matter of claim 8 is defined by its intended use on a mobile X-ray unit (PCT guidelines III-4.8a). This claim should have been directed to a "X-ray unit comprising a system according to any one of the previous claims". Such a definition is assumed for Item V below.
2. According to the description (page 5 line 18 - page 6 line 10), the use of a feedback circuit in the control means is a preferred embodiment, whereas these features are defined in independent claim 1 (PCT guidelines III-4.3).

Re item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Following document is cited in the present communication :

D1: EP-A-0253333

1. **Claim 1**

- 1.1 The following features are known from the prior art and are disclosed in combination in D1 Fig. 6 to 9 :

system for the controlled operation of a device such as a portable X-ray machine propelled by electric motors, which system comprises two drive wheels 12,14 mounted in an axially opposed manner, propelled by electromotive means, and control means to govern the propulsion of the drive wheels, wherein

each drive wheel 12,14 is propelled by an independent electric motor 18,20, and whereby independent control means are provided for each electric motor 18,20, which control means comprise an independent power amplifier 22,24 which amplifies electrical signals produced by sensor means 64,66, and supplies electric power to the corresponding electric motor 18,20; where the sensor means 64,66 detect a mechanical force of pushing and pulling applied to a push and pull element 16 by a user, and transform said mechanical force into electrical signals that indicate the degree of the force and the direction of the mechanical force applied on said push and pull element 16 (column 6 line 46 - column 7 line 9 and column 9 lines 4-12); the power amplifier 22,24 amplifies the signals and supplies the electric motor 18,20 in order that it propels the drive wheel 12,14 in accordance with a torque corresponding to the movement ordered by the sensor means 64,66; the sensor means 64,66 which control each electric motor 18,20 being capable of being operated separately in such a way that each drive wheel 12,14 is powered selectively.

Although it is not explicitly stated in D1 that the amplification factor is a function of the weight of the device, this feature *is implicit* from the aim of the invention (column 1 line 50 - column 2 line 4).

- 1.2 The subject-matter of claim 1 differs from that of D1, which is considered to represent the closest prior art, by that a feedback circuit, which compares the true power fed to the electric motor with a pre-established nominal value, is provided for each power amplifier. The subject-matter of claim 1 is therefore novel in the sense of article 33 (2) PCT as compared to that of D1. The effect of this feature is that the power fed to the electric motor can be altered, for example when the device is on a ramp, in order to provide the necessary power to the electric motor for it to perform the movement ordered by the sensor means (page 5 line 18 - page 6 line 10). This additional feature is neither disclosed in his present form nor rendered obvious by any of the documents cited in the search report. The subject-matter of claim 1 would therefore involve an inventive step in the sense of

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/ES99/00381

article 33 (3) PCT.

2. Dependent claims 2 to 8

Claims 2 to 8 are dependent from claim 1 and would therefore also meet the requirements of the PCT.

Re Item VII

Certain defects in the international application

- Contrary to Rule 6.3(b) (i) PCT, the features known in combination from the closest prior art D1 are not placed in a preamble of independent claim 1 (see Item V point 1.1).

- 1 -

TITLE OF THE INVENTION
SYSTEM FOR THE CONTROLLED OPERATION OF A DEVICE
PROPELLED BY ELECTRIC MOTOR

TECHNICAL FIELD OF THE INVENTION

5 The present invention lies within the technical field of devices propelled by an electromotive force and particularly in the sector of drive systems for electric trolleys and self-propelled devices.

STATE OF THE ART PRIOR TO THE INVENTION

10 At present, devices powered by electric motor, such as trolleys, fork-lifts or platforms for transporting loads, merchandise, pallets, crates, etc., jacks and self-propelled instruments like for example mobile X-ray units, find application in a plurality of industrial and
15 commercial sectors.

Such devices are usually propelled by one or more drive wheels operated by electric motors, with the facility for the operator to select between functions of start/stop, forward/reverse movement and, in some cases,
20 travelling speed. This type of device is handled by an operator standing on the floor who controls the direction and, where appropriate, the travelling speed by control means corresponding to the functions mentioned. The control means are usually situated on a lever or bar
25 which, in order to direct the device to the left or to the right, is usually coupled to a frame or platform, having said frame or platform one or more wheels which turn freely and are swivel-coupled to the front or rear part of the body of the device, so that the displacing of
30 the bar or lever to the right or to the left permits the device to be turned to the right or to the left.

These conventional devices, although very useful, have a number of drawbacks.

In this sense, a first drawback of the conventional
35 devices is that by having the operations of turning to

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the right or to the left done by manually positioning the direction of the free wheels, the possibility of performing turns in confined spaces proves complicated. Furthermore, with this type of device, it also proves
5 relatively complicated to move at an adequate speed and, consequently, for safe and precise handling, training in handling is necessary.

The European patent application EP 0 253 333 describes a control system for providing power to
10 independently driven wheels of a power driven cart for transporting medical diagnostic equipment. A manually engageable handle is mounted to the cart in a position allowing a person to exert a manual force on the handle in a direction in which it is desired for the cart to
15 move. Force sensors are coupled to the handle to sense the manual force applied to it in a plane parallel to the plane on which the cart is to be moved. The force sensors provide signals representative of the magnitude and direction of the manual force applied to the handle in
20 forward, reverse and turning directions. Electronic circuits are coupled to the force sensors for providing control signals to motors driving the wheels of the cart for independently controlling direction and velocity of movement of the cart.

25 The features known in combination from this European patent are placed in the preamble of independent claim 1.

OBJECT OF THE INVENTION

The object of the present invention is to overcome the drawbacks mentioned above by means of a system which
30 permits the controlled operation of a device propelled by electric motor, which is easy to handle without any need for intensive training, which can turn in confined spaces and which, in spite of being an active motorised element, behaves with a certain pasiveness which translates into a
35 sensation of heaviness for the operator which contributes

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to the operator's handling of the device being intuitive, very precise, easy and quick.

DESCRIPTION OF THE INVENTION

5 In accordance with the invention, the aforementioned objects are achieved by means of a system for the controlled operation of a device propelled by an electric motor which comprises at least two drive wheels fitted at opposite ends of an axle, propelled by electromotive means, and control means for governing the propulsion of
10 the drive wheels, in which each drive wheel is propelled by an independent electric motor and in that each electric motor is provided with independent control means. In accordance with the invention, these control means for each electric motor comprise an independent
15 power amplifier which amplifies electrical signals produced by sensor means, and feeds electric power to the electric motor. The sensor means detect the mechanical force of pushing and pulling applied to a push and pull element by a user, and transforms said mechanical force
20 into electrical signals indicating the degree of the force (e.g. strong, very strong or weak) at the direction (forward or backward) of the mechanical force applied in said push and pull element. The amplifier amplifies the signals in accordance with an amplification factor in
25 terms of the weight of the device, and feeds the electric motor so that it powers the drive wheel in accordance with a torque corresponding to the movement ordered by the sensor means. The sensor means which order each electric motor can be operated separately in such a
30 manner that each drive wheel can be propelled selectively.

In a preferred embodiment of the invention, the system comes with two wheels each propelled by its own electric motor as well as with first control means for
35 the first electric motor and second independent control

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means for the second electric motor. In accordance with this embodiment, the first control means comprises first sensor means required by a first push and pull means, and the second control means comprises second sensor means
5 required by a second push and pull means. Preferably, the first and the second push and pull element, are interconnected through a connecting element coupled in such a manner that pulling or pushing the connecting element by the user can act selectively on the first or
10 the second push element.

In a preferred embodiment of the invention, the connecting element is a handle whose extremities act respectively on the respective push and pull elements, which in turn act on the respective sensors. With this
15 arrangement, it is achieved that, by pushing or pulling the handle, the operator is able to manoeuvre in an especially easy and comfortable manner. Thus, when the handle is situated at the rear of the device and the operator wishes to start to move forwards, he has only to
20 grasp the handle with both hands, one on the left part of the handle and the other on its right part, and push it with the same force by both hands. In this manner, the extremities of the handle shall apply the same pressure on the two sensors which shall transmit the electrical
25 signals corresponding to their respective control means so that both electric motors operate at the same speed. When the operator wishes to turn to the right, he pushes the handle more firmly in his left hand, so that the control means on the left side order the electric motor
30 on the left to rotate at a greater speed than that on the right and, consequently, the left drive wheel turns more quickly than the right one and, if it is wished to turn to the left he pushes more firmly in his right hand in which case the control means of the right side and,
35 consequently, the right side electric motor and the right

-5-

drive wheel work in a way as the described above with respect to the manoeuvre of turning to the right. When the operator wishes to start to reverse, he pulls the handle instead of pushing it, in the same way as the
5 described before with respect to moving forwards.

When the operator wishes to turn the device around, he pushes the handle with the opposite hand to that of the turning direction and simultaneously he pulls the handle with his other hand. In this case, the motor and,
10 consequently, the drive wheel of the side on which the operator pulls the handle rotates backwards whereas the drive wheel on the side on which the operator pushes the handle rotates on the opposite direction, thereby making it possible for the device to turn around completely.

15 Likewise, the operator can select the travelling speed by simply pushing or pulling the handle with variable strength.

In a preferred embodiment of the system of the invention each of the control means also comprises first
20 preamplifier means which amplifies the electrical signals produced by the sensor means as a function of the pushing or pulling force detected, which feeds preamplified signals to the power amplifier which supplies the drive wheel. In this preferred embodiment, it is also
25 especially beneficial that each of the control means comprises also for each power amplifier, a feedback circuit which compares, by comparator means, the true value of electric power supplied to the electric motor with the pre-established value of electric power
30 necessary to achieve movement of the of the drive wheel, and transforms the difference detected -which arise for example when the drive wheel is on a ramp sloping upwards or downwards- between the true value and the pre-established value, into error signals by means of which
35 the input electrical signals to the power amplifier are

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altered in order that the latter supply the necessary power to the electric motor for it to rotate on a basis of the torque required to perform the movement ordered by the sensor means. In this manner it is achieved that the
5 unevenness of the surface over which the device is travelling is automatically offset insofar as its possible effect on the motion of the device is concerned, and the movement is therefore uniform. Appropriately, each feedback circuit comprises a second preamplifier
10 means which amplifies the error signals.

In an especially preferred embodiment of the system of the invention, the latter is incorporated into a mobile X-ray unit. It is well known these units are very heavy (400-600 kg, usually) and have to be capable of
15 being manoeuvred often in very confined spaces, by personnel not accustomed to handling this type of apparatus frequently.

According to the invention, the amplification factor applied to the power amplifier is calculated so that a
20 relation is maintained between the weight of the propelled device and the application of a reasonable force on the push and pull elements by the user.

As sensors for detecting the pushing or pulling force applied by the operator, use can be made of load
25 cells (like for example extension-measuring gauges), pressure detectors, and also piezoelectric, optical, magnetic, capacitive and resistive sensors.

As power amplifiers use can be made of standard instrumentation amplifiers and preamplifiers for the
30 input signals, such as those marketed by the company ANALOGUE DEVICE.

DESCRIPTION OF THE DRAWINGS

The invention is described hereunder on the basis of an embodiment shown in the drawings attached hereto
35 which form an integral part of this descriptive

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specification, in which:

figure 1 shows a schematic block diagram which shows the basic electronic and electrical elements of the system of the invention in an embodiment applied to a device propelled by two drive wheels;

figure 2 shows a schematic block diagram, corresponding to figure 1, of the basics elements related with the control of the left side drive wheel;

figure 3 shows a schematic plan view of the most significant components of the system in the embodiment illustrated in figure 1;

figure 4 is a schematic view of the disposition the handle, the left side force sensor and the left side push and pull element, shown in figure 3;

15 DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

As can be appreciated from figure 1, the system comprises a force sensor 1 which detects the mechanical force of pushing, +FI, or pulling, -FI, applied by the operator, and transmits signals indicating the forces detected to the power amplifier 2. The amplifier 2 amplifies the signal by a factor KI and supplies the resulting electric power to the left, direct current motor 3, which powers the left drive wheel 4. A feedback circuit 5 which measures the motor current which is proportional to the torque, detects any difference between the nominal value and the true value and generates, in the event of there being differences between these values, an error signal which is applied to the amplifier 2 in addition to the signal received from the force sensor 1. Figure 1 also shows the layout of the elements for controlling and propelling the right wheel, comprising the right force sensor 6 which detects the pushing +FD, or pulling forces, -FD, applied by the operator, the right amplifier 7, the right electric motor 8, the right drive wheel 9 and the right feedback circuit

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10. For the propulsion of the left wheel an entirely similar layout of elements is provided.

5 It can be appreciated from figure 2 that the left side feedback circuit 5 comprises a preamplifier 11 for the error signal and another preamplifier 12 for the signal received from the force sensor 1. The layout shown in figure 2 for the left side is entirely similar to the layout of elements on the right side (not shown in figure 2).

10 Figure 3 shows the physical layout of:
- the force sensors 1, 6 comprising extension-measuring gauges (VISHAY) 1a, 6a,
- the electric motors 3, 8,
15 - the drive wheels 4, 9 in a mobile X-ray unit 13,
- the push and pull elements 14, 15 comprising spring metal bands, anchored in respective fasteners 16, 17 of the unit 13 framework, said push and pull elements being joined to each other, at their outside extremities, by means of a handle
20 18.

It can also be appreciated that, in the embodiment shown in figure 3, the power supply is a set of rechargeable batteries 19.

25 Figure 4 shows in greater detail the layout of the force sensor 1a, of the push and pull element 14 and of its fastener 16, as well as of the handle 18.

From figures 3 and 4 it can be deduced that when the user pulls or pushes the handle 18, this results in a forward or backward spring deformation of the band corresponding 14, 15, which deformation is detected by the respective extension-measuring gauge 1a, 6a and converted into an electrical signal in accordance with that explained above. Due to the flexibility of the bands 14, 15, when the user is not pushing or pulling the
35 handle, released either intentionally or accidentally,

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the bands return to their stop position and, as a result, the motion of the unit is halted.

The embodiment illustrated in the figures can be applied, by way of example, to a self-propelled mobile X-ray unit, of approximately 400 kg in weight. In this case use can be made of two GSC electric motors 3, 8, each with a power of 500 W and a torque of 15 Nm, two ANALOGUE DEVICE power amplifiers, each of 500 W, which incorporate the preamplifiers 11, 12 of the left feedback circuit 5 and the preamplifiers (not shown) of the right feedback circuit 10. To provide the user with a sensation of heaviness which permits him to push and pull the unit with greater security, it has been calculated that he should apply a force, in respect of each hand, of between 0 (= stopped) and 4 kg when pushing +FI, +FD, or pulling -FI, -FD, detectable by the force sensors 1, 6. The power amplifiers 2, 7, multiply these pushing or pulling forces by factors KI, KD which can be set for example in 11 and feed the corresponding power to the electric motors 3, 8 so that they can propel the wheels 4, 9 with the necessary forces +KIFI, -KIFI, +KDFD, -KDFD. When the operator is moving the unit on a downward slope and is pushing with maximum force of 4 kg, this implies the unit will be travelling at the maximum attainable speed. When moving the unit over a flat floor or on an upward slope, the maximum speed is reduced in order to achieve a greater drive force. Depending on the force applied, the operator can therefore regulate the travelling speed over each surface.

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A M E N D E D C L A I M S

1.- A system for the controlled operation of a device propelled by electric motor,

5 said system comprising,

 at least two drive wheels mounted in an axially opposed manner, equipped with control means to govern the propulsion of the drive wheels, wherein each drive wheel (4, 9) is propelled by an
10 independent electric motor (3, 8) and independent control means provided for each electric motor, said control means comprising

 an independent power amplifier (2, 7) which amplifies electrical signals produced by sensor
15 means (1, 1a, 6, 6a), and supplies electric power to the corresponding electric motor (3, 8);

 sensor means (1, 1a, 6, 6a) for detecting a mechanical force (+FI, -FI, +FD, -FD) of pushing (+FI, +FD) and pulling (-FI, -FD) applied to a push
20 and pull element (14, 15) by a user, and transforming said mechanical force (+FI, -FI, +FD, -FD) into electrical signals that indicate the degree and the direction of the mechanical force applied on said push and pull element (14, 15),

25 said sensor means (1, 1a, 6, 6a) capable of being operated separately in such a way that each drive wheel (4, 9) is powered selectively

characterised in that,

30 the amplifier (2, 7) amplifies the signals in accordance with an amplification factor (KI, KD) as a function of the weight of the device (13) and supplies the electric motor in order that it propel the drive wheel (4, 9) in accordance with a torque
35 corresponding to the movement ordered by the sensor

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means (1, 1a, 6, 6a) where each one of the control means comprises in addition for each power amplifier (2, 7), a feedback circuit (5, 10) which compares, by means of a comparator means, the true value of the electric power fed to the electric motor with the pre-established nominal value of the electric power needed to achieve movement of the drive wheel, and transforms differences detected between the true value and the pre-established value into error signals (+II, -II, +ID, -ID) by means of which the electrical input signals to the power amplifier are altered in order that the latter supply the necessary power (+KIFI, -KIFI, +KDFD, -KDFD) to the electric motor (3, 8) in order that it can rotate on basis of the torque needed to produce the movement ordered by the sensor means (1, 1a, 6, 6a).

2. A system in accordance with claim 1, characterised in that it has at least a first and a second electric motor (3, 8) as well as a first independent control means for the first electric motor (3) and a second independent control means for the second electric motor (8), the first control means comprising a first sensor means (1, 1a) required by a first push and pull element (14), and the second control means comprising a second sensor means (6, 6a) required by a second push and pull element (15).

3. A system in accordance with claim 1 or 2, characterised in that each one of the control means also comprises a first preamplifier means (12) which amplifies the electrical signals produced by the sensor means (1, 1a, 6, 6a) as a function of the pushing or pulling force detected (+FI, -FI, +FD, -FD), which applies preamplified signals to the power amplifier (2, 7) which feeds the drive wheel.

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4. A system in accordance with claim 1, 2 or 3, characterised in that the feedback circuit (5, 10) comprises a second preamplifier means (11) which
5 amplifies the error signals (+II, -II).

5. A system in accordance with claim 2, characterised in that the first and the second push and pull elements (14, 15) which are connected to the first and second
10 force sensors (1, 1a, 6, 6a), are coupled to each other through a connecting element (18), said coupling being in such a manner that the pulling or pushing of the connecting element (18) by the user can act selectively on the first (14) or the second (15) push element.

15 6. A system in accordance with claim 5, characterised in that the first and second push and pull elements (14, 15) connected to the first and second force sensors (1, 1a, 6, 6a), and the connecting element (18), configure an
20 assembly formed by a handle.

7. A system in accordance with claim 5 or 6, characterised in that the push and pull elements (14, 15) are formed by bands whose first extremities are coupled
25 to the connecting element (18) and whose second extremities are held immobile in fasteners (16, 17), and in that the first and second force sensors (1, 1a, 6, 6a) are extension-measuring gauges (1a, 6a) arranged on the bands (14, 15) in such a manner that when the connecting
30 element is pushed or pulled, a deformation arises in the corresponding band (14, 15), said extension being detected by the pertinent gauge (1a, 6a).

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- 13 -

8. A system in accordance with any one of the previous claims, characterised in that the device propelled (13) is a mobile X-ray unit.

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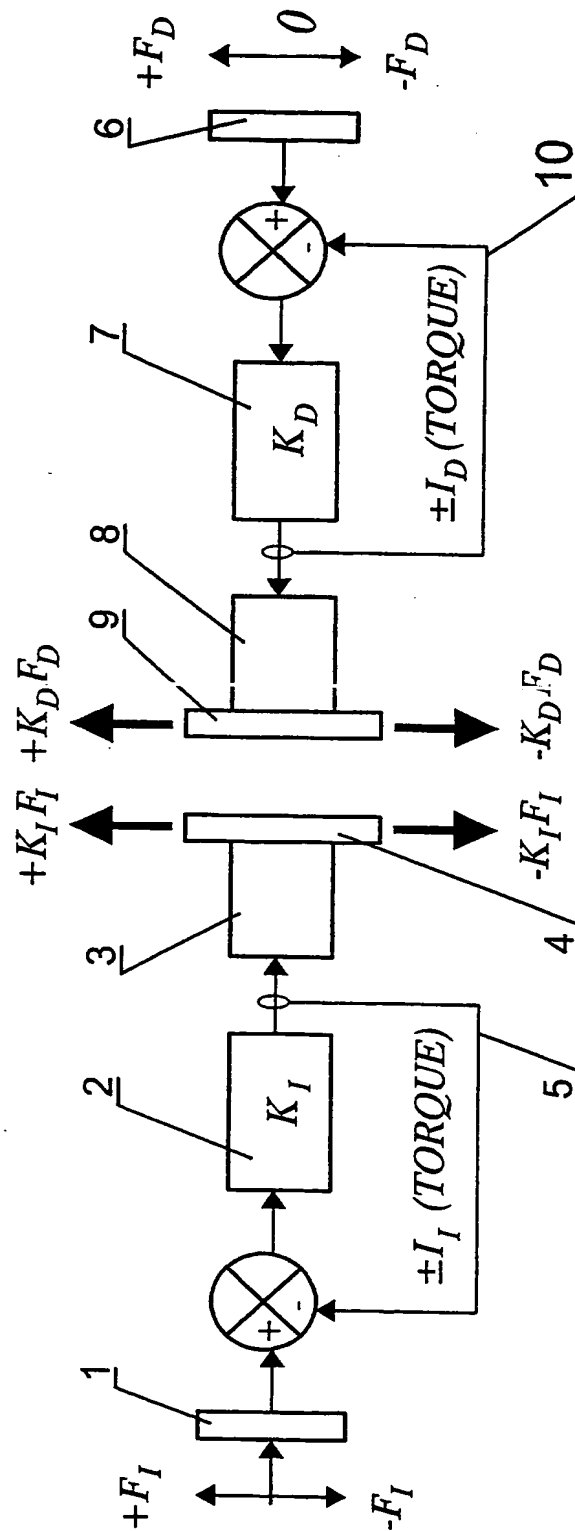
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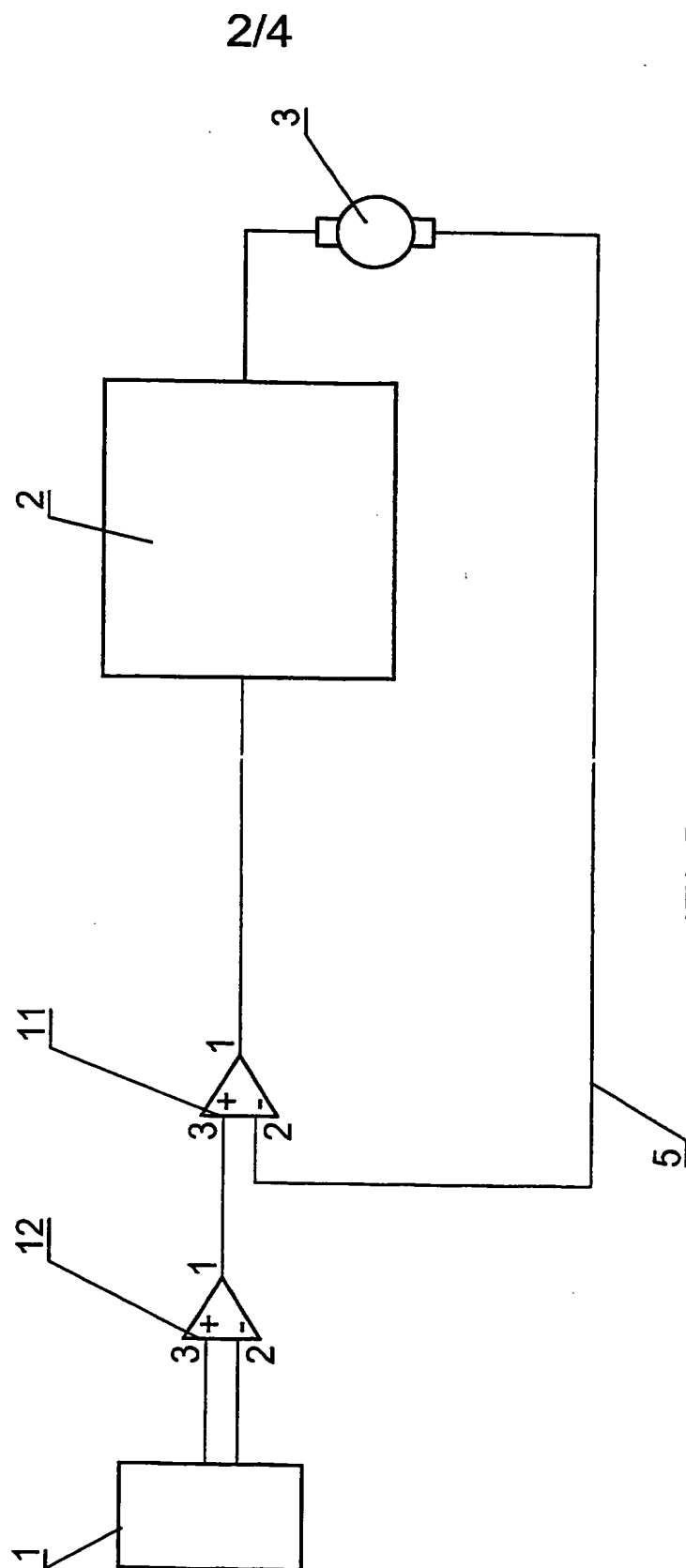
30

35

1/4



F/G.1



2/4

FIG. 2

3/4

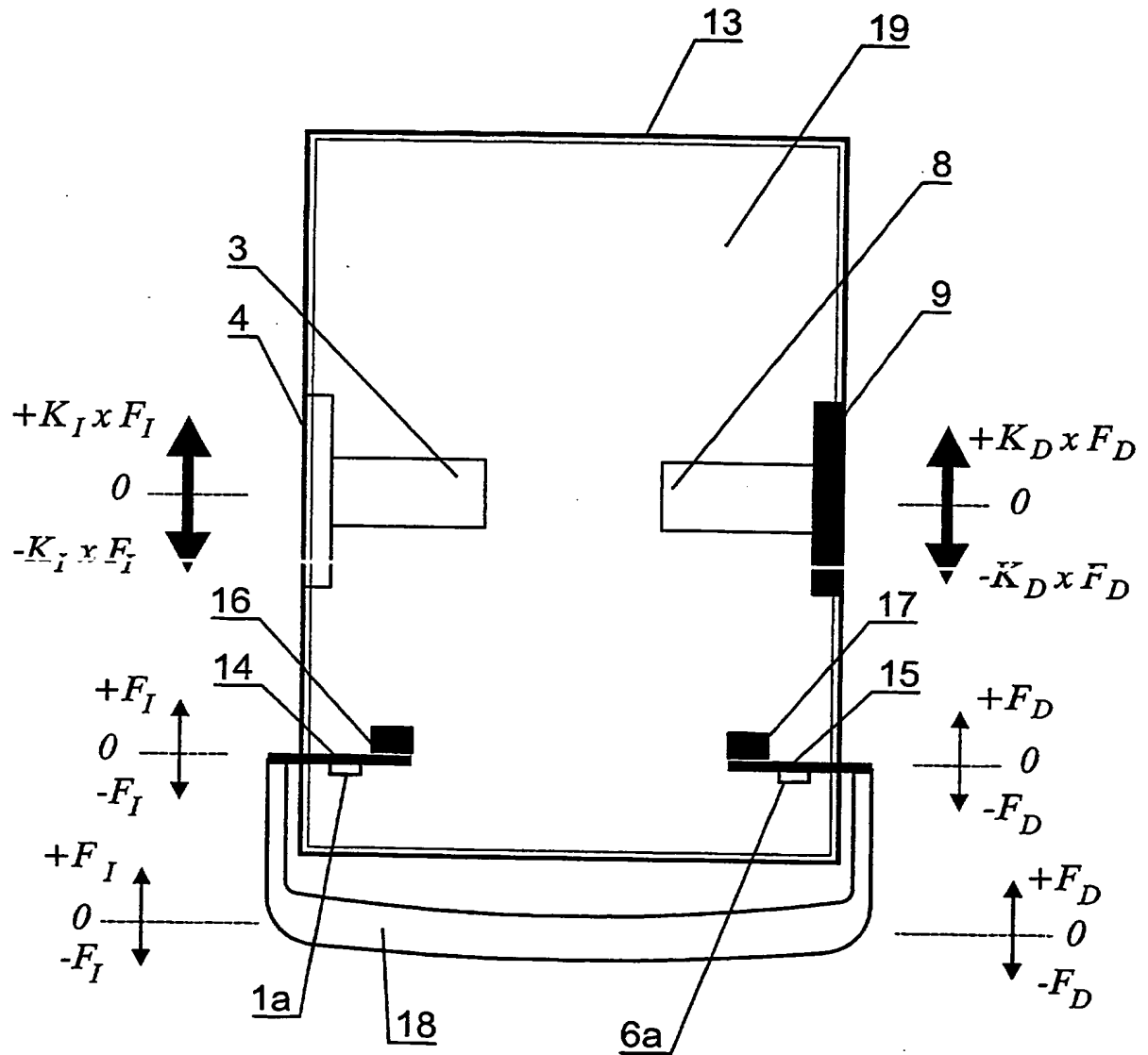


FIG. 3

4/4

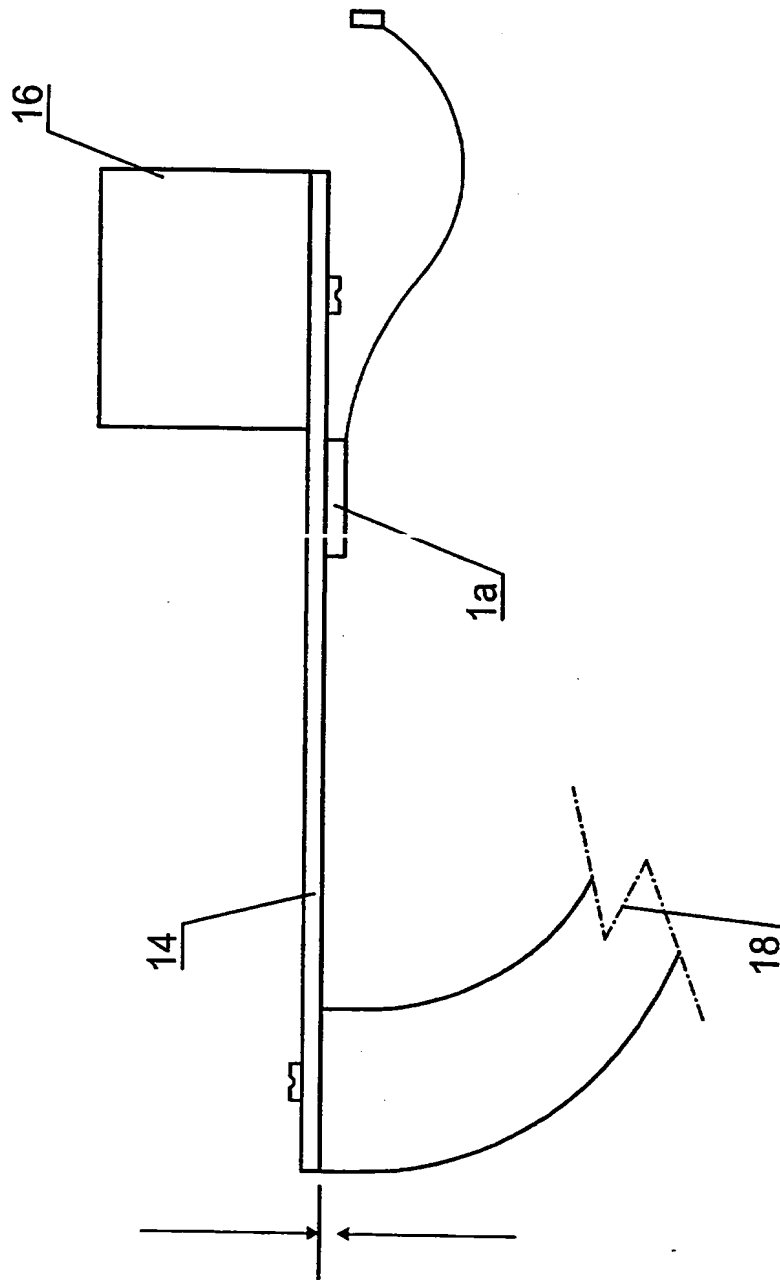


FIG. 4

TRATADO DE COOPERACIÓN EN MATERIA DE PATENTES

PCT

INFORME DE BÚSQUEDA INTERNACIONAL

(Artículo 18 y reglas 43 y 44 del PCT)

Referencia del expediente del solicitante o del mandatario	PARA CONTINUAR LA TRAMITACIÓN ver la notificación de transmisión del informe de búsqueda internacional (Formulario PCT/ISA/220) y, en su caso, el punto 5 de esta hoja.	
Solicitud internacional n° PCT/ES 99/00381	Fecha de presentación internacional (día/mes/año) 24 de noviembre de 1999 (24.11.1999)	Fecha de prioridad (la más antigua) (día/mes/año) 28 de noviembre de 1998 (28.11.1998)
Solicitantes: SOCIEDAD ESPAÑOLA DE ELECTROMEDICINA Y CALIDAD S. A., DÍAZ CARMENA, FRANCISCO Y DÍAZ CARMENA, ÁNGEL		

El presente informe de búsqueda internacional, elaborado por esta Administración encargada de la Búsqueda Internacional, se transmite al solicitante, conforme al artículo 18. Se remite una copia del mismo a la Oficina Internacional.

Este informe de búsqueda internacional comprende un total de **3** hojas.

☒ Se adjunta una copia de cada uno de los documentos citados en el informe relativos al estado de la técnica.

1. Consideraciones sobre el informe

a. En lo que se refiere al idioma, la búsqueda internacional se ha realizado sobre la solicitud internacional en el idioma en el cual se depositó, salvo indicación en contra señalada en este apartado.

☐ la búsqueda internacional se ha realizado sobre una traducción de la solicitud internacional facilitada a esta Administración (Regla 23.1 b)).

b. En lo que se refiere a las secuencias de nucleótidos y/o de aminoácidos divulgadas en la solicitud internacional (en su caso), la búsqueda internacional se ha basado en la lista de secuencias:

☐ contenida en la solicitud internacional en formato escrito.

☐ presentada conjuntamente con la solicitud internacional en soporte legible por ordenador.

☐ facilitada posteriormente a esta Administración por escrito.

☐ facilitada posteriormente a esta Administración en soporte legible por ordenador.

☐ se ha entregado la declaración, según la cual la lista de secuencias presentada por escrito posteriormente no va más allá de la divulgación hecha en la solicitud internacional tal y como fue presentada.

☐ se ha entregado la declaración, según la cual la información grabada en el soporte legible por ordenador es idéntica a la lista de secuencias presentada por escrito.

2. ☐ Se estima que algunas reivindicaciones no pueden ser objeto de búsqueda (ver recuadro I).

3. ☐ Falta unidad de invención (ver recuadro II).

4. Con respecto al título,

☐ el texto se aprueba según fue remitido por el solicitante.

☒ el texto ha sido establecido por esta Administración con la siguiente redacción:

SISTEMA DE CONTROL DE LOS MOTORES ELÉCTRICOS DE PROPULSIÓN DE UN CARRO DE TRANSPORTE

5. Con respecto al resumen,

☒ el texto se aprueba según fue remitido por el solicitante.

☐ el texto (reproducido en el recuadro III) ha sido establecido por esta Administración de conformidad con la regla 38.2b). El solicitante puede presentar observaciones a esta Administración en el plazo de un mes a contar desde la fecha de expedición del presente informe de búsqueda internacional.

6. La figura de los dibujos a publicar junto con el resumen es la siguiente: Figura n° **1**

☒ propuesta por el solicitante.

☐ No debe publicarse ninguna figura.

☐ por no haber propuesto el solicitante ninguna figura.

☐ por caracterizar mejor, esta figura, la invención.

INFORME DE BÚSQUEDA INTERNACIONAL

Solicitud internacional n°
PCT/ES/99/00381

A. CLASIFICACIÓN DEL OBJETO DE LA SOLICITUD

CIP: B62B 5/00, A61B 6/00, B60L 15/00

De acuerdo con la Clasificación Internacional de Patentes (CIP) o según la clasificación nacional y la CIP.

B. SECTORES COMPRENDIDOS POR LA BÚSQUEDA

Documentación mínima consultada (sistema de clasificación, seguido de los símbolos de clasificación)

CIP: B62B, A61B, B60L

Otra documentación consultada, además de la documentación mínima, en la medida en que tales documentos formen parte de los sectores comprendidos por la búsqueda:

Bases de datos electrónicas consultadas durante la búsqueda internacional (nombre de la base de datos y, si es posible, términos de búsqueda utilizados):

WPI, EPODOC, PAJ, OEPMPAT.

C. DOCUMENTOS CONSIDERADOS RELEVANTES

Categoría*	Documentos citados, con indicación, si procede, de las partes relevantes	Relevante para las reivindicaciones n°
X Y	EP 253 333 A1 (GENERAL ELECTRIC CO.) 20.01.1988; todo el documento.	1-3,6,7,9,10 4,5,8
Y	US 4 107 590 A1 (PURY ET AL.) 15.08.1978; columna 4, línea 9 - columna 5, línea 29; columna 6, línea 28 - columna 8, línea 6; figuras 4-6.	4,5,8
X A	US 5 425 069 A1 (PELLEGRINO ET AL.) 13.06.1995; columna 7, línea 47 - columna 8, línea 52; figuras 1, 2A, 9A-9C, 10.	1,2,6,7,9,10 8
A	EP 707 842 A1 (NABCO LTD.) 24.04.1996; página 3, línea 52 - página 4, línea 25; página 7, líneas 33-58; figuras 1-3, 7A-7C.	1,2,6-8

☐ En la continuación del recuadro C se relacionan otros documentos ☒ Los documentos de familia de patentes se indican en el anexo

* Categorías especiales de documentos citados:

"A" documento que define el estado general de la técnica no considerado como particularmente relevante.

"E" solicitud de patente o patente anterior pero publicada en la fecha de presentación internacional o en fecha posterior.

"L" documento que puede plantear dudas sobre una reivindicación de prioridad o que se cita para determinar la fecha de publicación de otra cita o por una razón especial (como la indicada).

"O" documento que se refiere a una divulgación oral, a una utilización, a una exposición o a cualquier otro medio.

"P" documento publicado antes de la fecha de presentación internacional pero con posterioridad a la fecha de prioridad reivindicada.

"T" documento ulterior publicado con posterioridad a la fecha de presentación internacional o de prioridad que no pertenece al estado de la técnica pertinente pero que se cita por permitir la comprensión del principio o teoría que constituye la base de la invención.

"X" documento particularmente relevante; la invención reivindicada no puede considerarse nueva o que implique una actividad inventiva por referencia al documento aisladamente considerado.

"Y" documento particularmente relevante; la invención reivindicada no puede considerarse que implique una actividad inventiva cuando el documento se asocia a otro u otros documentos de la misma naturaleza, cuya combinación resulta evidente para un experto en la materia.

"&" documento que forma parte de la misma familia de patentes.

Fecha en que se ha concluido efectivamente la búsqueda internacional. 8 de octubre de 1999 (08.10.1999)

Fecha de expedición del informe de búsqueda internacional

1 MAR 2000

1 MAR 2000

Nombre y dirección postal de la Administración encargada de la búsqueda internacional

O.E.P.M.
C/Panamá 1, 28071 Madrid, España.

Funcionario autorizado

ANDRÉS LÓPEZ ALONSO

n° de teléfono + 34 91 349 55 22 n° de fax +34 91 3495304

INFORME DE BÚSQUEDA INTERNACIONAL

Información relativa a miembros de familias de patentes

Solicitud internacional nº

PCT/ ES 99/00381

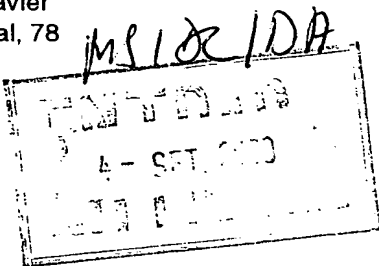
Documento de patente citado en el informe de búsqueda	Fecha de publicación	Miembro(s) de la familia de patentes	Fecha de publicación
EP 253 333 A1	20.01.1988	US 4 697 661 A1	06.10.1987
		DK 87 03663 A	15.01.1988
		JP 63 021 038 A	28.01.1988
		DE 3 784 794 G	22.04.1993
US 4 107 590 A1	15.08.1978	DE 2 746 016 A	20.04.1978
		NL 77 09906 A	20.04.1978
US 5 425 069 A1	13.06.1995	CA 2 136 708 A1	27.05.1995
		CA 2 259 633 A1	27.05.1995
		CA 2 261 105 A1	27.05.1995
		GB 2 284 331 A1	31.05.1995
		DE 4 441 236 A1	01.06.1995
		FR 2 712 796 A1	02.06.1995
		FR 2 716 613 A1	01.09.1995
		FR 2 716 614 A1	01.09.1995
		US 5 499 284 A1	12.03.1996
		DE 4 447 727 A1	14.08.1997
		DE 4 447 728 A1	14.08.1997
		GB 2 318 265 A1	15.04.1998
		GB 2 318 266 A1	15.04.1998
		GB 2 284 331 B1	17.06.1998
		CA 2 136 708 C	08.06.1999
		DE 4 447 728 C2	11.11.1999
EP 707 842 A1	24.04.1996	NINGUNO	

PATENT COOPERATION TREATY

From the:
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

UNGRIA LOPEZ, Javier
Avda. Ramon y Cajal, 78
E-28043 MADRID
ESPAGNE



PCT

WRITTEN OPINION

(PCT Rule 66)

Date of mailing (day/month/year)		30.08.2000
Applicant's or agent's file reference 199.222/MAD		REPLY DUE within 3 month(s) from the above date of mailing
International application No. PCT/ES99/00381	International filing date (day/month/year) 24/11/1999	Priority date (day/month/year) 28/11/1998
International Patent Classification (IPC) or both national classification and IPC B62B5/00		
Applicant SOCIEDAD ESPAÑOLA DE ELECTROMEDICINA ... et al.		


- This written opinion is the **first** drawn up by this International Preliminary Examining Authority.
- This opinion contains indications relating to the following items:
 - ☒ Basis of the opinion
 - ☐ Priority
 - ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - ☐ Lack of unity of invention
 - ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - ☐ Certain document cited
 - ☒ Certain defects in the international application
 - ☒ Certain observations on the international application
- The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4. For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis. For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.
- The final date by which the international preliminary examination report must be established according to Rule 69.2 is: **28/03/2001**.

Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer / Examiner Fuchs, A Formalities officer (incl. extension of time limits) Radoch, M Telephone No. +49 89 2399 2847
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I. Basis of the opinion

1. This opinion has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed".*):

Description, pages:

1-9 as originally filed

Claims, No.:

1-10 as originally filed

Drawings, sheets:

1/4-4/4 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

3. This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**1. Statement**

Novelty (N)	Claims 1-3, 6-10
Inventive step (IS)	Claims
Industrial applicability (IA)	Claims

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item VIII

Certain observations on the international application

The present application does not meet the requirements of article 6 PCT, because the subject-matter of the claims is unclear. The reasons are given hereafter.

1. In order to define clearly the features of the claimed system, line 2 of claim 1 should read : system for the controlled operation of a device propelled by electric motor, *said system* comprises ... (PCT guidelines III-4.1).
2. In claim 2, reference should be made to a first and a second independent *control means* instead of first and second *means for control of* ... (PCT rule 10.2). For the same reason, reference should always be made to the *push and pull elements* in claims 6, 7 and 8.
3. The wording of claim 2 is also unclear with respect of the use of "the first control means consisting of first : ..., and secondly : ...".
Furthermore, the control means, as defined in claim 1 (lines 11-23) would *comprise* an independent power amplifier and sensor means, whereas, according to the wording of claim 2, the control means are only *consisting of* a sensor means, which formulation would exclude the power amplifier. The subject-matter of claim 2 would therefore be inconsistent with that of claim 1, and with the description page 3 lines 13-26 (PCT guidelines III-4.3).

In the present case, it would appear that the correct wording for lines 2-8 of claim 2 should be : ...electric motor (3,8) as well as a first independent *control means* for the first electric motor (3) and a second independent *control means* for the second electric motor (7), the first *control means comprising a first sensor means* (1,1a) required by a first push and pull element (13), and *the second control means comprising a second sensor means* (5,5a) required by a second push and pull element (14).

This corrected wording is taken into account for the purpose of examination with

regard to novelty and inventive step (see Item V).

4. According to the description, the verb "consisting of" should also be replaced by "comprising" in claims 3 to 5 (see point 3).
5. The subject-matter of claim 9 is defined by its intended use on a mobile X-ray unit (PCT guidelines III-4.8a). It is assumed that this claim will be directed to a mobile X-ray unit comprising a system according to any one of the previous claims.

Re Item V

Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Following documents are cited in the present communication :

D1: EP-A-0253333
D2: US-A-5425069
D3: EP-A-0707842

1. **Claim 1**

The following features are known from the prior art and are disclosed in combination in D1 Fig. 6 to 9 :

system for the controlled operation of a device such as a portable X-ray machine propelled by electric motors, which system comprises two drive wheels 12,14 mounted in an axially opposed manner, propelled by electromotive means, and control means to govern the propulsion of the drive wheels, wherein each drive wheel 12,14 is propelled by an independent electric motor 18,20, and whereby independent control means are provided for each electric motor 18,20, which control means comprise an independent power amplifier 22,24 which amplifies electrical signals produced by sensor means 64,66, and supplies electric power to the corresponding electric motor 18,20; where the sensor means 64,66 detect a mechanical force of pushing and pulling applied

to a push and pull element 16 by a user, and transform said mechanical force into electrical signals that indicate the degree of the force and the direction of the mechanical force applied on said push and pull element 16 (column 6 line 46 - column 7 line 9 and column 9 lines 4-12);
the power amplifier 22,24 amplifies the signals and supplies the electric motor 18,20 in order that it propels the drive wheel 12,14 in accordance with a torque corresponding to the movement ordered by the sensor means 64,66;
the sensor means 64,66 which control each electric motor 18,20 being capable of being operated separately in such a way that each drive wheel 12,14 is powered selectively.

Although it is not explicitly stated in D1 that the amplification factor is a function of the weight of the device, this feature is implicit from the aim of the invention (column 1 line 50 - column 2 line 4).

All features of claim 1 being disclosed in combination in D1, the subject-matter of this claim lacks novelty in the sense of article 33 (2) PCT as compared to D1. It should be noted that D2 (column 7 and 8 and drawings 9 to 10) and D3 would also disclose all features of present claim 1.

2. Dependent claims 2 to 10

2.1 The additional features of claim 2 are also disclosed in D1, D2 and D3, where each control means comprise a sensor means fitted on a push and pull element.

2.2 The preamplifiers defined in claim 3 are also disclosed in D1 (Fig. 6 elements 26,28 and column 4 line 44-53).

2.3 The additional features of claims 6, 7 and 8 are also disclosed in D1 (Fig. 7) :
- handle 16 can selectively act on the first or second push and pull element, and is coupled to each of them,
- bands 72,74 coupled at one end to the handle 16 and at the other end on the X-ray device, said bands comprising extension-measuring gauges G1 to G4;
and in D2 and D3.

2.4 The subject-matter of claim 4 differs from that of D1, which is considered to represent the closest prior art, by that a feedback circuit, which compares the true power fed to the electric motor with a pre-established nominal value, is provided for each power amplifier. The subject-matter of claim 4 is therefore novel in the sense of article 33 (2) PCT as compared to that of D1. The effect of this feature is that the power fed to the electric motor can be altered, for example when the device is on a ramp, in order to provide the necessary power to the electric motor for it to perform the movement ordered by the sensor means (page 5 lines 6-27 and page 7 lines 5-12). This additional feature is neither disclosed in his present form nor rendered obvious by any of the documents cited in the search report. The subject-matter of claim 4 would therefore involve an inventive step in the sense of article 33 (3) PCT. It is suggested that a new independent claim be drafted to include these features, bearing in mind that the features known in combination from D1 should be placed in the preamble of such a claim in accordance with Rule 6.3 b) PCT.

2.5 Claim 5 is dependent from claim 4 and would therefore also meet the requirements of the PCT.

2.6 A mobile X-ray unit, as defined in claim 9, and comprising a system in accordance with claim 1, would not be novel as compared to that of D1, for the reasons given in point 2.1.

2.7 The additional features of claim 10 are implicit features for such type of system (see point 2.1).

Re Item VII

Certain defects in the international application

- / ^a - Contrary to rule 5 (1) a) PCT, the closest prior art D1 is neither cited nor briefly disclosed in the description.
- / ^b - Contrary to rule 6.3(b) (i) PCT, the features known in combination from the closest prior art D1 are not placed in a preamble of independent claim 1.

**WRITTEN OPINION
SEPARATE SHEET**

International application No. PCT/ES99/00381

- X - In the description page 7 lines 21-22, the preamplifiers should respectively have the reference signs 10 and 11.
- X - The wording "characterized because" should be replaced by "characterized in that" in all claims, the use of the word "because" being unclear in the present context.
- X - Reference sign "5" should not be used for two different features (left side wheel and right side feedback circuit).



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e-mail: levante@ungria.es

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**CORRESPONSALES ESPECIALIZADOS
EN TODOS LOS PAISES DEL MUNDO**

REG. MERC. MADRID, HOJA M-36005, FOLIO 184
TOMO 2019. INSCRIPCIÓN 1ª. C.I.F. A-28378578

JU/HA/IGM/yo

Madrid, 24 November 2000

Via DHL

Re.: International Patent Application No.: PCT/ES99/00381
Priority: Spanish Patent Application P9802534 of the 28th
November 1998

Applicants: SOCIEDAD ESPAÑOLA DE
ELECTROMEDICINA...et al.

O/Ref.: 199222/MAD

Dear Sirs:

(1) In response to the first Written Opinion issued on the above referenced application, the following is submitted on behalf of the applicants:

- * replacement sheets 1-9 with a description
- * replacement sheets 10-13 with a new set of claims 1-8
- * explanatory sheets 1-14 which are copies of pages 1-14 of original English translation in which amendments to the description and claims have been inserted in handwriting, and an additional sheet -2A- showing further amendments made in the description
- * replacement sheets 1-4 of the drawings

(1.1) As readily apparent, the amended claims are supported in the original disclosure of this application as follows:

- Amended claim 1 is supported in original claims 1 and 4.
- Amended claims 2-3 are supported in original claims 2-3.
- Original claim 4 has been deleted and the subject matter thereof has been included in amended claim 1.

- Amended claims 4-8 are supported in original claims 5-9.
- Original claim 10 has been deleted.

When reviewing the description and claims for making the amendments, we also made some clerical self-evident amendments aimed to improve the language of the application and to correct some minor errors.

(1.2) The amendments in the description are as follows:

Some of the self-evident linguistic amendments made

- in original page 1, line 24, "which" has been replaced by "The control means";
- in original page 1, line 26, "said frame or platform" has been inserted after "having";
- in original page 1, line 27, "which in turn is" has been replaced by "and are";
- in original page 3, line 32, "is" has been replaced by "in";
- in original page 4, lines 9 and 14, "with more force" has been replaced by "more firmly";
- in original page 4, line 10, "of" has been replaced by "on";
- in original page 4, line 12, page 7, line 25, "left" has been replaced by "right";
- in original page 6, line 25, page 7, line 20, "right" has been replaced by "left".

In page 2, after line 7, a brief description of the identification and discussion of document D1 has been inserted.

(1.3) The amendments in claims are as follows:

All claims have been amended by replacing the wording "characterized because" by "characterized in that" as per examiner's suggestion.

The features known in combination from the closest prior art D1 have been placed in the preamble of independent amended claim 1.

Original claim 10 has been deleted given that the features reflected there are implicit for this type of systems.

(1.4) Amendments throughout the entire text of the application:

The verb "consisting of" has been replaced by "comprising".

The wording "means of control" has been replaced by "control means".

The numerical references in the specification, claims and drawings have been corrected.

(1.5) In view of the above, it is submitted that the amended claims and amendments in the description as submitted herewith, are directly and unambiguously derivable from and do not extend beyond the disclosure of the present application as originally filed, and they are thus admissible.

(2) The original claims 1-3, 6-10 of the present application were objected for lacking novelty over the disclosures of D1.

Amended claim 1 as submitted herewith is considered to define subject matter which is novel and inventive because of the following reasons:

D1 discloses a control system for providing power to independently driven wheels of a power driven cart with a similar arrangement to the one described in the present application. There is however, as already pointed out by the examiner, no teaching or suggestion in D1 from which the skilled person could infer that by providing said control system with a feedback circuit the operation of the cart would be improved in the following way:

When the device is moving at a specific speed and a variation on the resistant torque appears –as for example in a ramp- the operator no longer needs to modify their force on the handle, because thanks to the feedback circuit, the input signal to the control system is the difference between the signal needed to compensate this alteration and the signal coming from the sensors attached to the handle on which the operator applies the force to drive the device. If the control system lacks said feedback circuit, the operator should modify their driving force to maintain the speed of the device.

In view of the above, it is submitted that the invention as now claimed is novel, unobvious and unexpectedly advantageous, and thus patentable over D1.

It is submitted that all amendments are self-evident and unambiguously derivable from the original disclosure.

(4) Favourable consideration of the present submissions is earnestly solicited. Should the examiner have further objections or objections to any of the amendments made, issuance of a corresponding second Written Opinion is requested. In view of the fact that the term until the IPER must be established will not expire until the 28th March 2001, sufficient time for issuance of such a second Written Opinion and a eventually filing a response thereto should be available.



Respectfully submitted,



Javier UNGRIA

Enc.: *

TITLE OF THE INVENTIONSYSTEM FOR THE CONTROLLED OPERATION OF A DEVICE
PROPELLED BY ELECTRIC MOTORTECHNICAL FIELD OF THE INVENTION

5 The present invention lies within the technical field of devices propelled by an electromotive force and particularly in the sector of drive systems for electric trolleys and self-propelled devices.

STATE OF THE ART PRIOR TO THE INVENTION

10 At present, devices powered by electric motor, such as trolleys, fork-lifts or platforms for transporting loads, merchandise, pallets, crates, etc., jacks and self-propelled instruments like for example mobile X-ray units, find application in a plurality of industrial and
15 commercial sectors.

Such devices are usually propelled by one or more drive wheels operated by electric motors, with the facility for the operator to select between functions of start/stop, forward/reverse movement and, in some cases,
20 travelling speed. This type of device is handled by an operator standing on the floor, who controls the direction and, where appropriate, the travelling speed by <--> means ~~of controls~~ corresponding to the functions mentioned. ~~which~~ ^{<-->} are usually situated on a lever or bar
25 which, in order to direct the device to the left or to the right, is usually coupled to a frame or platform, having <<-->> one or more wheels which turn freely ~~which in turn is~~ >-< swivel-coupled to the front or rear part of the body of the device, so that the displacing of the bar or lever to
30 the right or to the left permits the device to be turned to the right or to the left.

These conventional devices, although very useful, have a number of drawbacks.

In this sense, a first drawback of the conventional
35 devices is that by having the operations of turning to << said frame or platform >>>
> and are <

<control>
<<The control means>>

the right or to the left done by manually positioning the direction of the free wheels, the possibility of performing turns in confined spaces proves complicated. Furthermore, with this type of device, it also proves
5 relatively complicated to move at an adequate speed and, consequently, for safe and precise handling, training in handling is necessary. >>- <<

OBJECT OF THE INVENTION

The object of the present invention is to overcome
10 the drawbacks mentioned above by means of a system which permits the controlled operation of a device propelled by electric motor, which is easy to handle without any need for intensive training, which can turn in confined spaces and which, in spite of being an active motorised element,
15 behaves with a certain passiveness which translates into a sensation of heaviness for the operator which contributes to the operator's handling of the device being intuitive, very precise, easy and quick.

DESCRIPTION OF THE INVENTION

20 In accordance with the invention, the aforementioned objects are achieved by means of a system for the controlled operation of a device propelled by an electric motor which comprises at least two drive wheels fitted at opposite ends of an axle, propelled by
25 electromotive means, and ^{<->} means ~~of control~~ for governing the propulsion of the drive wheels, in which each drive wheel is propelled by an independent electric motor and in that each electric motor is provided with independent ^{<->} means ~~of control~~. In accordance with the invention, these ^{<->}
30 means ~~of control~~ for each electric motor comprise an independent power amplifier which amplifies electrical signals produced by sensor means, and feeds electric power to the electric motor. The sensor means detect the mechanical force of pushing and pulling applied to a push
35 and pull element by a user, and transforms said

<control>

The European patent application EP 0 253 333 describes a control system for providing power to independently driven wheels of a power driven cart for transporting medical diagnostic equipment. A manually
5 engageable handle is mounted to the cart in a position allowing a person to exert a manual force on the handle in a direction in which it is desired for the cart to move. Force sensors are coupled to the handle to sense the manual force applied to it in a plane parallel to the
10 plane on which the cart is to be moved. The force sensors provide signals representative of the magnitude and direction of the manual force applied to the handle in forward, reverse and turning directions. Electronic circuits are coupled to the force sensors for providing
15 control signals to motors driving the wheels of the cart for independently controlling direction and velocity of movement of the cart.

The features known in combination from this European patent are placed in the preamble of independent claim 1.

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30

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mechanical force into electrical signals indicating the degree of the force (e.g. strong, very strong or weak) and the direction (forward or backward) of the mechanical force applied in said push and pull element. The
5 amplifier amplifies the signals in accordance with an amplification factor in terms of the weight of the device, and feeds the electric motor so that it powers the drive wheel in accordance with a torque corresponding to the movement ordered by the sensor means. The sensor
10 means which order each electric motor can be operated separately in such a manner that each drive wheel can be propelled selectively.

In a preferred embodiment of the invention, the system comes with two wheels each propelled by its own
15 electric motor as well as with first ^{<->} means ~~of control~~ for the first electric motor and second independent ^{<->} means ~~of control~~ for the second electric motor. In accordance with this embodiment, the first ^{<->} means ~~of control~~ comprises first sensor means required by a first push and pull
20 means, and the second ^{<->} means ~~of control~~ comprises second sensor means required by a second push and pull means. Preferably, the first and the second push and pull element, are interconnected through a connecting element coupled in such a manner that pulling or pushing the
25 connecting element by the user can act selectively on the first or the second push element.

In a preferred embodiment of the invention, the connecting element is a handle whose extremities act respectively on the respective push and pull elements,
30 which in turn act on the respective sensors. With this arrangement, it is achieved that, by pulling or pushing the handle, the operator is able to manoeuvre ^{>>-<<} ~~is~~ an ^{>>in<<} especially easy and comfortable manner. Thus, when the handle is situated at the rear of the device and the
35 operator wishes to start to move forwards, he has only to
~~<control>~~

grasp the handle with both hands, one on the left part of the handle and the other on its right part, and push it with the same force by both hands. In this manner, the extremities of the handle shall apply the same pressure on the two sensors which shall transmit the electrical signals corresponding to their respective means^{<->} of ~~control~~ so that both electric motors operate at the same speed. When the operator wishes to turn to the right, he pushes the handle^{>>>-<<<} with ~~more force~~ in his left hand, so that the^{<->} means of ~~control~~^[-] of the left side order the electric motor on the left to rotate at a greater speed than that on the ~~left~~^{[[]]} and, consequently, the left drive wheel turns more quickly than the right one and, if it is wished to turn to the left he pushes^{>>>-<<<} with ~~greater force~~ in his right hand in which case the^{<->} means of ~~control~~ of the right side and, consequently, the right side electric motor and the right drive wheel work in a ~~like manner to~~^{[[[-]]]} that described above with respect to the manoeuvre of turning to the right. When the operator wishes to start to reverse, he pulls the handle instead of pushing it, in⁽⁻⁾ ~~like manner to that~~ described before with respect to moving forwards.

When the operator wishes to turn the device around, he pushes the handle with the opposite hand to that of the turning direction and simultaneously he pulls the handle with his other hand. In this case, the motor and, consequently, the drive wheel of the side on which the operator pulls the handle rotates backwards⁽⁻⁾ whilst the drive wheel^[-] of the side on which the operator pushes the handle rotates in the opposite direction, thereby making it possible for the device to turn around completely.

Likewise, the operator can select the travelling speed by simply pushing or pulling the handle with ~~more~~^{(((-)))} or less force.

In a preferred embodiment of the system of the
<control> [[right]] ((whereas))
>>> more firmly <<< [[[way as the]]] (((variable strength)))
[on] (the same way as the)

invention each of the ^{<->} means ~~of control~~ also comprises first preamplifier means which amplifies the electrical signals produced by the sensor means as a function of the pushing or pulling force detected, which feeds
5 preamplified signals to the power amplifier which supplies the drive wheel. In this preferred embodiment, it is also especially beneficial that each of the ^{<->} means ~~of control~~ comprises also for each power amplifier, a feedback circuit which compares, by comparator means, the
10 true value of ~~the~~ electric power supplied to the electric motor with the pre-established value of electric power necessary to achieve movement of the drive wheel, and transforms differences detected, which arise for example when the drive wheel ~~controlled by the latter~~ is on a
15 ramp sloping upwards or downwards, between the true value and the pre-established value, into error signals by means of which the input electrical signals to the power amplifier are altered in order that the latter supply the necessary power to the electric motor for it to rotate on
20 a basis of the torque required to perform the movement ordered by the sensor means. In this manner it is achieved that the unevenness of the surface over which the device is travelling is automatically offset insofar as its possible effect on the motion of the device is
25 concerned, and the movement is therefore uniform. Appropriately, each feedback circuit comprises a second preamplifier means which amplifies the error signals.

In an especially preferred embodiment of the system of the invention, the latter is incorporated into a
30 mobile X-ray unit. It is well known these units are very heavy (400 - 600 kg, usually) and have to be capable of being manoeuvred often in very confined spaces, by personnel not accustomed to handling this type of apparatus frequently.

35 According to the invention, the amplification factor

applied by the power amplifier is calculated so that a relation is maintained between the weight of the propelled device and the application of a reasonable force on the push and pull elements by the user.

5 As sensors for detecting the pushing or pulling force applied by the operator, use can be made of load cells (like for example extension-measuring gauges), pressure detectors, and also piezoelectric, optical, magnetic, capacitive and resistive sensors.

10 As power amplifiers use can be made of standard instrumentation amplifiers ~~which already incorporate a feedback circuit~~ and preamplifiers for the input signals, such as those marketed by the company ANALOGUE DEVICE.

DESCRIPTION OF THE DRAWINGS

15 The invention is described hereunder on the basis of an embodiment shown in drawings attached hereto which form an integral part of this descriptive specification, in which:

figure 1 shows a schematic block diagram which
20 shows the basic electronic and electrical elements of the system of the invention in an embodiment applied to a device propelled by two drive wheels;

figure 2 shows a schematic block diagram,
corresponding to figure 1, of the basic elements related
25 with the control of the ~~right~~ side drive wheel;

figure 3 shows a schematic plan view of the most significant components of the system in the embodiment illustrated in figure 1;

figure 4 is a schematic view of the disposition of
30 the handle, the left side force sensor and the left side push and pull element, shown in figure 3.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

As can be appreciated from figure 1, the system comprises a force sensor 1 which detects the mechanical
35 force of pushing +FI or pulling -FI applied by the

{left}

operator, and transmits signals indicating the forces detected to the power amplifier 2. The amplifier 2 amplifies the signal by a factor KI and supplies the resulting electric power to the left, direct current motor 3, which powers the left drive wheel 4. A feedback circuit 5 which measures the motor current which is proportional to the torque, detects any difference between the nominal value and the true value and generates, in the event of there being differences between these values, an error signal which is applied to the amplifier 2 in addition to the signal received from the force sensor 1 ~~can also be observed~~. Figure 1 also shows the layout of the elements for controlling and propelling the right wheel, consisting of the right force sensor ~~6~~^{6a} which detects the pushing forces, +FD, ~~and or~~ pulling forces, -FD, applied by the operator, the right amplifier⁷ the right electric motor~~8~~^{8a} and the right feedback circuit~~10~~^{10a}. For the propulsion of the left wheel, an entirely similar layout of elements is provided.

It can be appreciated from figure 2 that the ~~right~~ side feedback circuit 5 comprises a preamplifier~~11~~^{11a} for the error signal and another preamplifier~~12~~^{12a} for the signal received from the force sensor 1. The layout shown in figure 2 for the right side is entirely similar to the layout of elements on the ~~left~~ side (not shown in figure 2).

Figure 3 shows the physical layout of: the force sensors 1, ~~6~~^{6a}, ~~consisting of~~^{11a-11b} extension-measuring gauges (VISHAY) 1a, ~~6a~~^{6a}, ~~of~~ the electric motors 3, ~~8~~^{8a} and ~~of~~ the drive wheels 4, ~~9~~^{9a} in a mobile X-ray unit^{13, 12}, Figure 3 ~~also shows~~ push and pull elements 13, 14 ~~consisting of~~ spring metal bands, anchored in respective fasteners~~16~~^{16a}, of the unit^{13, 12} framework ~~and which are~~ joined to each other, at their outside extremities, by means of a handle ~~17~~^{17a}. It can also be appreciated that, in the embodiment

the right drive wheel
left

[[right]]
comprising

the
said push and pull elements

shown in figure 3, the power supply is a set of rechargeable batteries ~~18~~.¹⁹

Figure 4 shows in greater detail the layout of the force sensor 1a, of the push and pull element⁴~~13~~ and of its fastener⁶~~13~~, as well as of the handle ~~17~~.¹⁸

From figures 3 and 4 it can be deduced that when the user pulls or pushes the handle⁸~~17~~, this results in a forward or backward spring deformation of the band corresponding ¹⁴~~13~~, ¹⁵~~14~~, which deformation is detected by the respective extension-measuring gauge 1a, ~~6~~⁷ and converted into an electrical signal in accordance with that explained above. Due to the flexibility of the bands ¹⁴~~13~~, ¹⁵~~14~~, when the user is not pushing or pulling the handle, released either intentionally or accidentally, the bands return to their stop position and, as a result, the motion of the unit is halted.

The embodiment illustrated in the figures can be applied, by way of example, to a self-propelled mobile X-ray unit, of approximately 400 kg in weight. In this case use can be made of two GSC electric motors ~~3~~,⁸~~7~~, each with a power of 500 W and a torque of 15 Nm, two ANALOGUE DEVICE power amplifiers, each of 500 W, which incorporate the preamplifiers ¹¹~~10~~, ¹²~~11~~ of the left feedback circuit 5 and the preamplifiers (not shown) of the right feedback circuit ¹⁰~~9~~. To provide the user with a sensation of heaviness which permits him to push and pull the unit with greater security, it has been calculated that he should apply a force, with respect to each hand, of between 0 (= stopped) and 4 kg when pushing +FI, +FD, or pulling -FI, ~~11-16~~, detectable by the force sensors ~~1~~,⁶~~7~~. The power amplifiers ~~2~~,⁷~~8~~, multiply these pushing or pulling forces by factors KI, KD which can be set for example in ¹¹~~10~~ and feed the corresponding power to the electric motors ~~3~~,⁸~~7~~ so that they can propel the wheels ~~4~~,⁹~~8~~ with the necessary forces +KIFI, -KIFI, +KDFD, -

]]-FD[[

KDFD. When the operator is moving the unit on a downward slope and is pushing with maximum force of 4 kg, this implies the unit will be travelling at the maximum attainable speed. When moving the unit over a flat floor or on an upward slope, the maximum speed is reduced in order to achieve a greater drive force. Depending on the force applied, the operator can therefore regulate the travelling speed over each surface.

A said system comprising
all equipped with
) for detecting

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CLAIMS

1.- A System for the controlled operation of a device propelled by electric motor, ¹¹⁻¹¹ which ~~comprises~~ at least two drive wheels mounted in an axially opposed manner, ¹¹⁻¹¹ ~~propelled by electromotive means, and control means to govern the propulsion of the drive wheels, characterised because~~

wherein each drive wheel (4, 9) is propelled by an independent electric motor (3, 7) and ~~because~~ independent control means ~~are~~ provided for each electric motor, ~~7), which control means comprise~~ said control means comprising

an independent power amplifier (2, 7) which amplifies electrical signals produced by sensor means (1, 1a, 6, 6a), and supplies electric power to the corresponding electric motor (3, 7); where

~~the~~ sensor means (1, 1a, 6, 6a) ~~detect~~ a mechanical force (+FI, -FI, +FD, -FD) of pushing (+FI, +FD) and pulling (-FI, -FD) applied to a push and pull element ¹⁴ (13, 14) by a user, and transform said mechanical force (+FI, -FI, +FD, -FD) into electrical signals that indicate the degree of the force and the direction of the mechanical force applied on said push and pull element

¹⁴ (13, 14); ¹⁵

the amplifier (2, 7) amplifies the signals in accordance with an amplification factor (KI, KD) as a function of the weight of the device (12) and supplies the electric motor in order that it propel the drive wheel (5, 8) in accordance with a torque corresponding to the movement ordered by the sensor means (1, 1a, 5, 5a);

~~said the sensor means (1, 1a, 6, 6a) which control each electric motor (3, 7) being capable of being operated separately in such a way that each drive wheel (8, 9) is powered selectively.~~

characterised in that ^{original} {the subject-matter of claim 4 has been inserted}

2. A System in accordance with claim 1, characterised

)) in that ((
<control>
))) comprising)))

))) second ((
comprises

- 11 -

)) - ((
~~because~~ it has at least a first and a second
electric motor (3, 8) as well as first independent
<-> means ~~of control~~ for the first electric motor (3)
and a second independent ~~means of control~~ for the
5 second electric motor (7), the first ~~means of~~
~~control~~ ~~consisting of a first~~ sensor means (1, 1a)
required by a first push and pull element (13), and
~~secondly:~~ the control means ~~consisting of a second~~
10 sensor means (6, 6a) required by a second push and
pull element (14).

3. A System in accordance with claim 1 or 2,
characterised ~~because~~ each one of the control means
~~consists also of~~ a first preamplifier means (12, 11)
15 which amplifies the electrical signals produced by
the sensor means (1, 1a, 6, 6a) as a function of the
pushing or pulling force detected (+FI, -FI, +FD, -
FD), which applies preamplified signals to the power
amplifier (2, 7) which feeds the drive wheel.

4. System in accordance with claim 1, 2 or 3,
characterised because each one of the control means
consists of in addition for each power amplifier (2,
25 6), a feedback circuit (5, 9) which compares, by
means of a comparator means, the true value of the
electric power fed to the electric motor with the
pre-established nominal value of the electric power
needed to achieve movement of the drive wheel, and
transforms differences detected between the true
30 value and the pre-established value into error
signals (+II, -II, +ID, -ID) by means of which the
electrical input signals to the power amplifier are
altered in order that the latter supply the
necessary power (+KFI, -KFI, +KFD, -KFD) to the
35 electric motor (3, 7) in order that it can rotate on

)) in that ((
comprises

- 12 -

} basis of the torque needed to produce the movement }
} ordered by the sensor means (1, 1a, 5, 5a). }

4~~6~~. A System in accordance with claim 4, characterised))-((
5 ~~because~~ the feedback circuit (5, 10~~8~~) ~~#-#~~ consists of a
second preamplifier means (1~~0~~) which amplifies the
error signals (+II, -II).

5~~6~~. A System in accordance with claim 2, characterised))-((
10 ~~because~~ the first and the second push and pull
elements (1~~3~~, 1~~5~~ 1~~4~~) which are connected to the first
and second force sensors (1, 1a, 6~~8~~, 6~~8~~a), are coupled
to each other through a connecting element (1~~2~~ 1~~7~~),
said coupling being in such a manner that the
15 pulling or pushing of the connecting element (1~~2~~ 1~~7~~) by
the user can act selectively on the first (1~~3~~ 1~~4~~) or
the second (1~~5~~ 1~~4~~) push element.

6~~7~~. A System in accordance with claim 5~~6~~, characterised))-((
20 ~~because~~ the first and second push or pull elements
(1~~4~~ 1~~3~~, 1~~5~~ 1~~4~~) connected to the first and second force
sensors (1, 1a, 6~~8~~, 6~~8~~a), and the connecting element
(1~~2~~ 1~~7~~), configure an assembly formed by a handle.

25 7~~8~~. A System in accordance with claim 5~~6~~ or 6~~7~~,
characterised))-((~~because~~ the push or pull elements (1~~3~~, 1~~4~~
(1~~5~~ 1~~4~~) are formed by bands whose first extremities are
coupled to the connecting element (1~~2~~ 1~~7~~)¹⁸ and whose
second extremities are held immobile in fasteners
30 16 (1~~5~~, 1~~7~~ 1~~6~~), and ~~because~~ the first and second force
sensors (1, 1a, 6~~8~~, 6~~8~~a) are extension-measuring
gauges (1a, 6~~8~~a) arranged on the bands (1~~3~~, 1~~5~~ 1~~4~~) in
such a manner that when the connecting element is
pushed or pulled, a deformation arises in the
35 corresponding band (1~~3~~, 1~~5~~ 1~~4~~), said extension being

//in that((
"the device propelled is"

- 13 -

detected by the pertinent gauge (1a, ^b/_a).

8. A System in accordance with any one of the previous
claims, characterised ^{//-(} because ~~it is incorporated in~~ ^{//"}
a mobile X-ray unit.

5

10. System in accordance with claim 1, characterised
because the amplification factor (K) is established
as a function of the weight of the device (12)
propelled and the application of a reasonable force
to the push and pull elements (13, 14) by the user.

10

A B S T R A C T

**SYSTEM FOR THE CONTROLLED OPERATION OF A DEVICE
DRIVEN BY ELECTRIC MOTOR**

5 A system is described for the controlled propulsion
of a transporting device ~~which consists of~~ at least two
drive wheels propelled by electromotive means, in which
system at least two drive wheels are each propelled by
independent electric motors; each electric motor receives
10 electric power through an independent power amplifier
which amplifies electrical signals produced by sensor
means; the sensor means detect a mechanical force applied
on a push and pull element, and convert said mechanical
force into electrical signals which indicate the degree
15 and the direction of the mechanical force applied on said
push and pull element; and the amplifier amplifies the
signal in accordance with a factor which is a function of
the weight that the trolley has to move and it feeds the
electric motor so it can power the drive motor in
20 accordance with a torque corresponding to the movement
ordered through the sensor means.

comprising

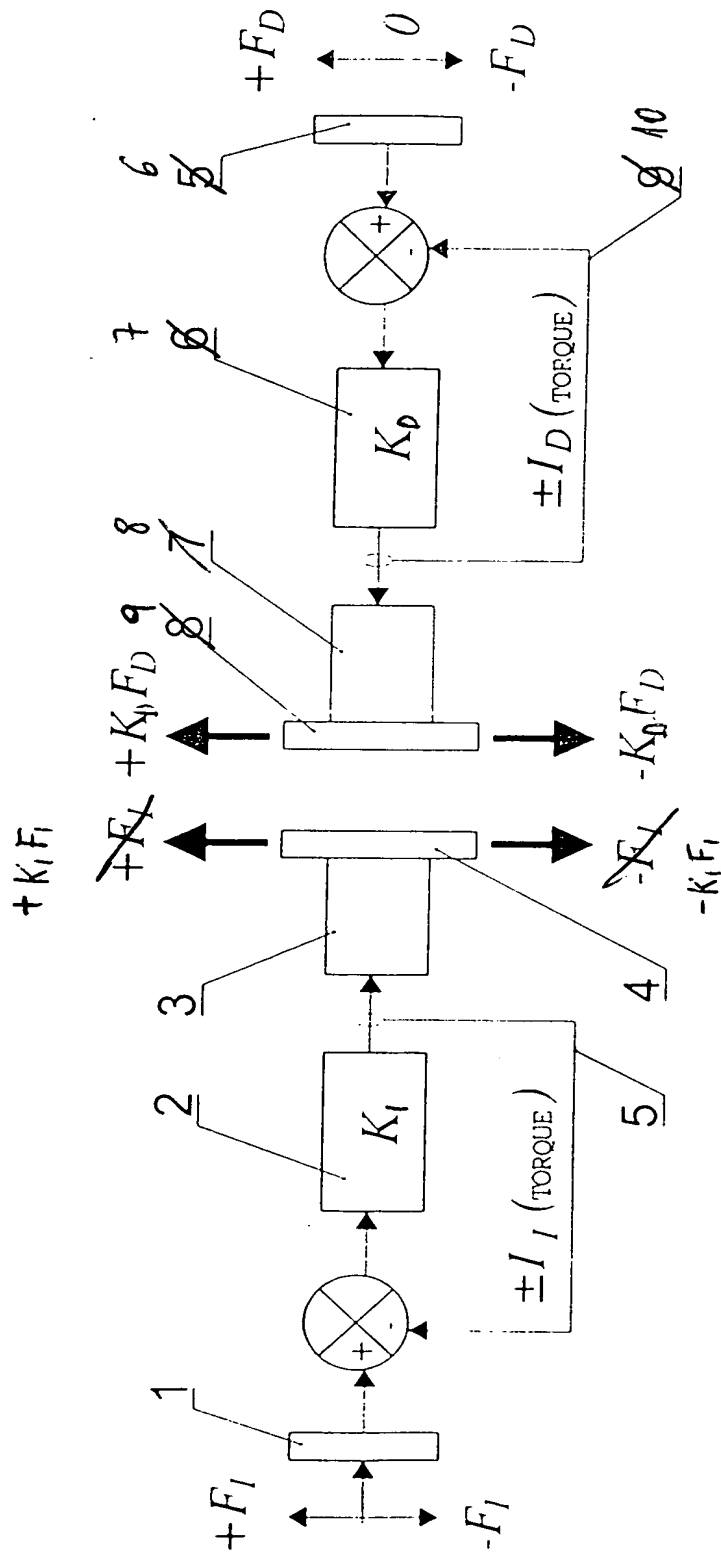


FIG. 1

2/4

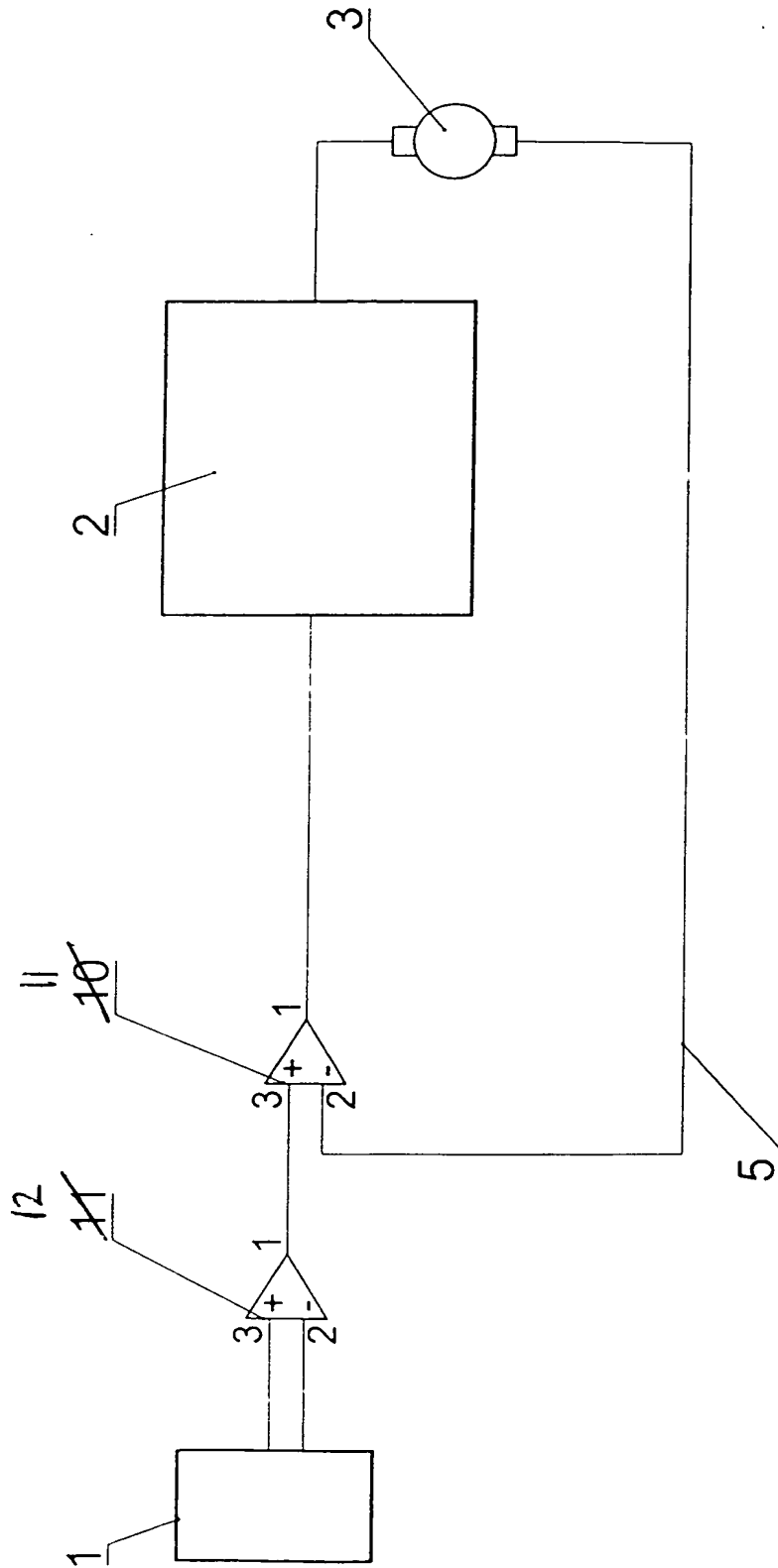


FIG. 2

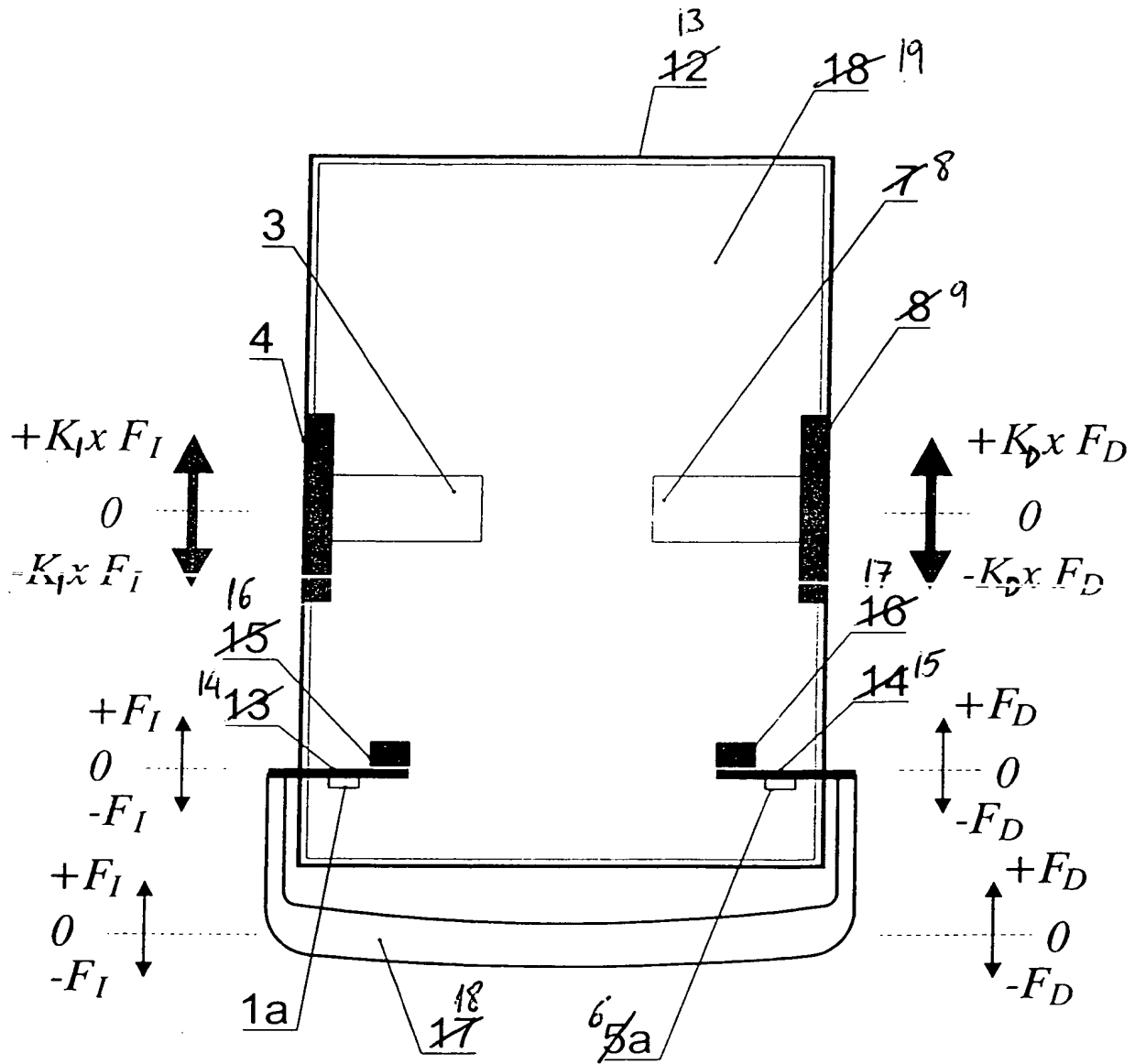


FIG. 3

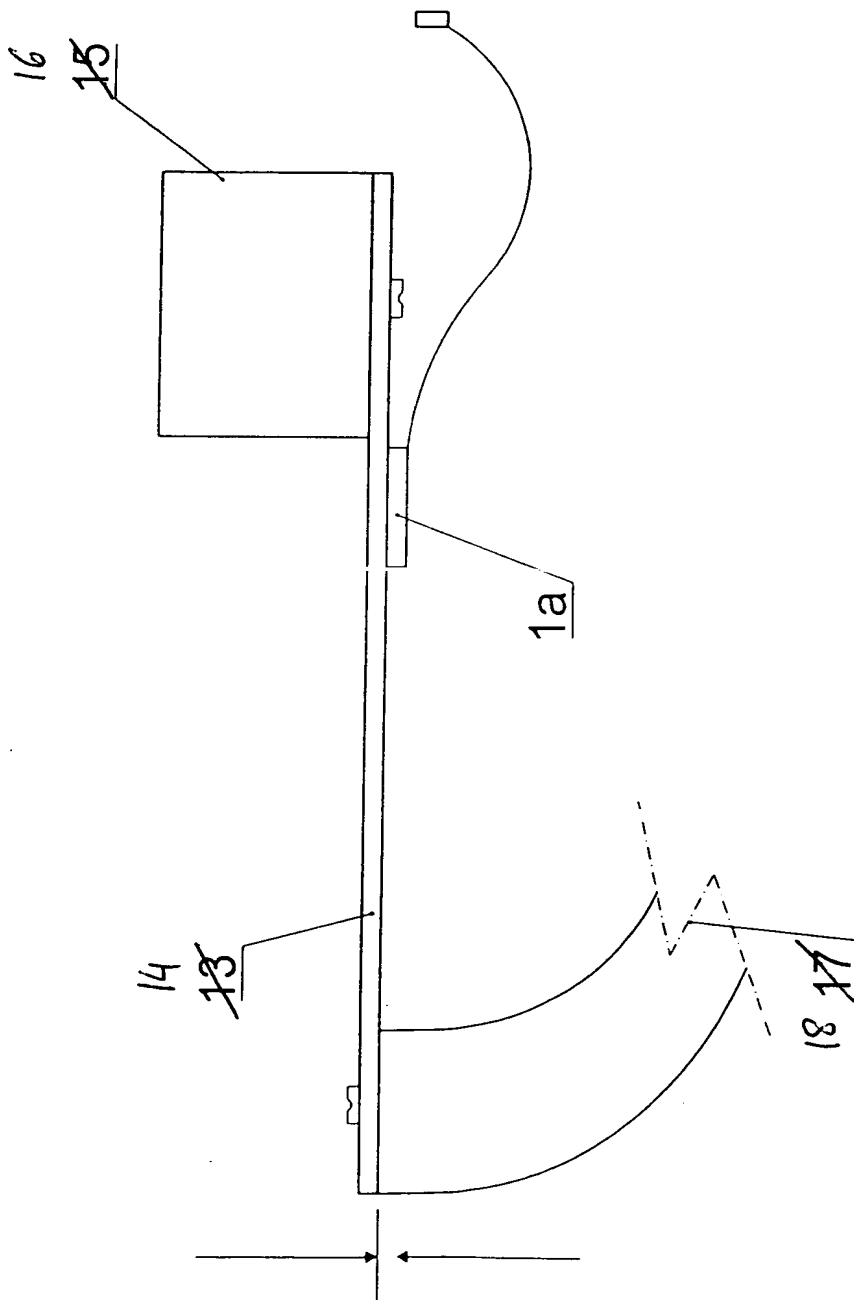


FIG. 4

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JC Rec'd PCT/PTO 2 5 MAY 2001

**TRANSLATION OF THE INTERNATIONAL APPLICATION
AS ORIGINALLY FILED**

- 1 -

TITLE OF THE INVENTION

**SYSTEM FOR THE CONTROLLED OPERATION OF A DEVICE
PROPELLED BY ELECTRIC MOTOR**

TECHNICAL FIELD OF THE INVENTION

5 The present invention lies within the technical field of devices propelled by an electromotive force and particularly in the sector of drive systems for electric trolleys and self-propelled devices.

STATE OF THE ART PRIOR TO THE INVENTION

10 At present, devices powered by electric motor, such as trolleys, fork-lifts or platforms for transporting loads, merchandise, pallets, crates, etc., jacks and self-propelled instruments like for example mobile X-ray units, find application in a plurality of industrial and
15 commercial sectors.

Such devices are usually propelled by one or more drive wheels operated by electric motors, with the facility for the operator to select between functions of start/stop, forward/reverse movement and, in some cases,
20 travelling speed. This type of device is handled by an operator standing on the floor, who controls the direction and, where appropriate, the travelling speed by means of controls corresponding to the functions mentioned which are usually situated on a lever or bar
25 which in order to direct the device to the left or to the right, is usually coupled to a frame or platform having one or more wheels which turn freely which in turn is swivel-coupled to the front or rear part of the body of the device, so that the displacing of the bar or lever to
30 the right or to the left permits the device to be turned to the right or to the left.

These conventional devices, although very useful, have a number of drawbacks.

35 In this sense, a first drawback of the conventional devices is that by having the operations of turning to

the right or to the left done by manually positioning the direction of the free wheels, the possibility of performing turns in confined spaces proves complicated. Furthermore, with this type of device, it also proves
5 relatively complicated to move at an adequate speed and, consequently, for safe and precise handling, training in handling is necessary.

OBJECT OF THE INVENTION

The object of the present invention is to overcome
10 the drawbacks mentioned above by means of a system which permits the controlled operation of a device propelled by electric motor, which is easy to handle without any need for intensive training, which can turn in confined spaces and which, in spite of being an active motorised element,
15 behaves with a certain passiveness which translates into a sensation of heaviness for the operator which contributes to the operator's handling of the device being intuitive, very precise, easy and quick.

DESCRIPTION OF THE INVENTION

20 In accordance with the invention, the aforementioned objects are achieved by means of a system for the controlled operation of a device propelled by an electric motor which comprises at least two drive wheels fitted at opposite ends of an axle, propelled by
25 electromotive means, and means of control for governing the propulsion of the drive wheels, in which each drive wheel is propelled by an independent electric motor and in that each electric motor is provided with independent means of control. In accordance with the invention, these
30 means of control for each electric motor comprise an independent power amplifier which amplifies electrical signals produced by sensor means, and feeds electric power to the electric motor. The sensor means detect the mechanical force of pushing and pulling applied to a push
35 and pull element by a user, and transforms said

mechanical force into electrical signals indicating the degree of the force (e.g. strong, very strong or weak) and the direction (forward or backward) of the mechanical force applied in said push and pull element. The
5 amplifier amplifies the signals in accordance with an amplification factor in terms of the weight of the device, and feeds the electric motor so that it powers the drive wheel in accordance with a torque corresponding to the movement ordered by the sensor means. The sensor
10 means which order each electric motor can be operated separately in such a manner that each drive wheel can be propelled selectively.

In a preferred embodiment of the invention, the system comes with two wheels each propelled by its own
15 electric motor as well as with first means of control for the first electric motor and second independent means of control for the second electric motor. In accordance with this embodiment, the first means of control comprises first sensor means required by a first push and pull
20 means, and the second means of control comprises second sensor means required by a second push and pull means. Preferably, the first and the second push and pull element, are interconnected through a connecting element coupled in such a manner that pulling or pushing the
25 connecting element by the user can act selectively on the first or the second push element.

In a preferred embodiment of the invention, the connecting element is a handle whose extremities act respectively on the respective push and pull elements,
30 which in turn act on the respective sensors. With this arrangement, it is achieved that, by pulling or pushing the handle, the operator is able to manoeuvre in an especially easy and comfortable manner. Thus, when the handle is situated at the rear of the device and the
35 operator wishes to start to move forwards, he has only to

grasp the handle with both hands, one on the left part of the handle and the other on its right part, and push it with the same force by both hands. In this manner, the extremities of the handle shall apply the same pressure
5 on the two sensors which shall transmit the electrical signals corresponding to their respective means of control so that both electric motors operate at the same speed. When the operator wishes to turn to the right, he pushes the handle with more force in his left hand, so
10 that the means of control of the left side order the electric motor on the left to rotate at a greater speed than that on the left and, consequently, the left drive wheel turns more quickly than the right one and, if it is wished to turn to the left he pushes with greater force
15 in his right hand in which case the means of control of the right side and, consequently, the right side electric motor and the right drive wheel work in a like manner to that described above with respect to the manoeuvre of turning to the right. When the operator wishes to start
20 to reverse, he pulls the handle instead of pushing it, in like manner to that described before with respect to moving forwards.

When the operator wishes to turn the device around, he pushes the handle with the opposite hand to that of
25 the turning direction and simultaneously he pulls the handle with his other hand. In this case, the motor and, consequently, the drive wheel of the side on which the operator pulls the handle rotates backwards whilst the drive wheel of the side on which the operator pushes the
30 handle rotates in the opposite direction, thereby making it possible for the device to turn around completely.

Likewise, the operator can select the travelling speed by simply pushing or pulling the handle with more or less force.

35 In a preferred embodiment of the system of the

invention each of the means of control also comprises first preamplifier means which amplifies the electrical signals produced by the sensor means as a function of the pushing or pulling force detected, which feeds preamplified signals to the power amplifier which supplies the drive wheel. In this preferred embodiment, it is also especially beneficial that each of the means of control comprises also for each power amplifier, a feedback circuit which compares, by comparator means, the true value of the electric power supplied to the electric motor with the pre-established value of electric power necessary to achieve movement of the drive wheel, and transform differences detected, which arise for example when the drive wheel controlled by the latter is on a ramp sloping upwards or downwards, between the true value and the pre-established value, into error signals by means of which the input electrical signals to the power amplifier are altered in order that the latter supply the necessary power to the electric motor for it to rotate on a basis of the torque required to perform the movement ordered by the sensor means. In this manner it is achieved that the unevenness of the surface over which the device is travelling is automatically offset insofar as its possible effect on the motion of the device is concerned, and the movement is therefore uniform. Appropriately, each feedback circuit comprises a second preamplifier means which amplifies the error signals.

In an especially preferred embodiment of the system of the invention, the latter is incorporated into a mobile X-ray unit. It is well known these units are very heavy (400 - 600 kg, usually) and have to be capable of being manoeuvred often in very confined spaces, by personnel not accustomed to handling this type of apparatus frequently.

According to the invention, the amplification factor

applied by the power amplifier is calculated so that a relation is maintained between the weight of the propelled device and the application of a reasonable force on the push and pull elements by the user.

5 As sensors for detecting the pushing or pulling force applied by the operator, use can be made of load cells (like for example extension-measuring gauges), pressure detectors, and also piezoelectric, optical, magnetic, capacitive and resistive sensors.

10 As power amplifiers use can be made of standard instrumentation amplifiers which already incorporate a feedback circuit and preamplifiers for the input signals, such as those marketed by the company ANALOGUE DEVICE.

DESCRIPTION OF THE DRAWINGS

15 The invention is described hereunder on the basis of an embodiment shown in drawings attached hereto which form an integral part of this descriptive specification, in which:

figure 1 shows a schematic block diagram which
20 shows the basic electronic and electrical elements of the system of the invention in an embodiment applied to a device propelled by two drive wheels;

figure 2 shows a schematic block diagram,
corresponding to figure 1, of the basic elements related
25 with the control of the right side drive wheel;

figure 3 shows a schematic plan view of the most significant components of the system in the embodiment illustrated in figure 1;

figure 4 is a schematic view of the disposition of
30 the handle, the left side force sensor and the left side push and pull element, shown in figure 3.

DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

As can be appreciated from figure 1, the system comprises a force sensor 1 which detects the mechanical
35 force of pushing +FI or pulling -FI applied by the

operator, and transmits signals indicating the forces detected to the power amplifier 2. The amplifier 2 amplifies the signal by a factor K and supplies the resulting electric power to the left, direct current
5 motor 3, which powers the left drive wheel 4. A feedback circuit 5 which measures the motor current which is proportional to the torque, detects any difference between the nominal value and the true value and generates, in the event of there being differences
10 between these values, an error signal which is applied to the amplifier 2 in addition to the signal received from the force sensor 1 can also be observed. Figure 1 also shows the layout of the elements for controlling and propelling the right wheel, consisting of the right force
15 sensor 5 which detects the pushing forces, +FD, and pulling forces, -FD, applied by the operator, the right amplifier, the right electric motor 7 and the right feedback circuit 9. For the propulsion of the left wheel, an entirely similar layout of elements is provided.

20 It can be appreciated from figure 2 that the right side feedback circuit 5 comprises a preamplifier 9 for the error signal and another preamplifier 10 for the signal received from the force sensor 1. The layout shown in figure 2 for the right side is entirely similar to the
25 layout of elements on the left side (not shown in figure 2).

Figure 3 shows the physical layout of the force sensors 1, 5, consisting of extension-measuring gauges (VISHAY) 1a, 5a, of the electric motors 3, 7 and of the
30 drive wheels 4, 8 in a mobile X-ray unit 12. Figure 3 also shows push and pull elements 13, 14 consisting of spring metal bands, anchored in respective fasteners 15, 16 of the unit 12 framework and which are joined to each other, at their outside extremities, by means of a handle
35 17. It can also be appreciated that, in the embodiment

shown in figure 3, the power supply is a set of rechargeable batteries 18.

Figure 4 shows in greater detail the layout of the force sensor 1a, of the push and pull element 13 and of its fastener 15, as well as of the handle 17.

From figures 3 and 4 it can be deduced that when the user pulls or pushes the handle 17, this results in a forward or backward spring deformation of the band corresponding 13, 14, which deformation is detected by the respective extension-measuring gauge 1a, 5a and converted into an electrical signal in accordance with that explained above. Due to the flexibility of the bands 13, 14, when the user is not pushing or pulling the handle, released either intentionally or accidentally, the bands return to their stop position and, as a result, the motion of the unit is halted.

The embodiment illustrated in the figures can be applied, by way of example, to a self-propelled mobile X-ray unit, of approximately 400 kg in weight. In this case use can be made of two GSC electric motors 3, 7, each with a power of 500 W and a torque of 15 Nm, two ANALOGUE DEVICE power amplifiers, each of 500 W, which incorporate the preamplifiers 10, 11 of the left feedback circuit 5 and the preamplifiers (not shown) of the right feedback circuit 9. To provide the user with a sensation of heaviness which permits him to push and pull the unit with greater security, it has been calculated that he should apply a force, with respect to each hand, of between 0 (= stopped) and 4 kg when pushing +FI, -FD, or pulling -FI, +FD, detectable by the force sensors 1, 5. The power amplifiers 2, 6, multiply these pushing or pulling forces by factors KI, KD which can be set for example in 10 and feed the corresponding power to the electric motors 3, 7 so that they can propel the wheels 4, 8 with the necessary forces +KIFI, -KIFI, +KDFD, -

KDFD. When the operator is moving the unit on a downward slope and is pushing with maximum force of 4 kg, this implies the unit will be travelling at the maximum attainable speed. When moving the unit over a flat floor or on an upward slope, the maximum speed is reduced in order to achieve a greater drive force. Depending on the force applied, the operator can therefore regulate the travelling speed over each surface,

C L A I M S

1.- System for the controlled operation of a device propelled by electric motor which comprises at least two drive wheels mounted in an axially opposed manner, propelled by electromotive means, and control means to govern the propulsion of the drive wheels, characterised because

each drive wheel (4, 8) is propelled by an independent electric motor (3, 7) and because independent control means are provided for each electric motor (3, 7), which control means comprise

an independent power amplifier (2, 6) which amplifies electrical signals produced by sensor means (1, 1a, 5, 5a), and supplies electric power to the corresponding electric motor (3, 7); where

the sensor means (1, 1a, 5, 5a) detect a mechanical force (+FI, -FI, +FD, -FD) of pushing (+FI, +FD) and pulling (-FI, -FD) applied to a push and pull element (13, 14) by a user, and transform said mechanical force (+FI, -FI, +FD, -FD) into electrical signals that indicate the degree of the force and the direction of the mechanical force applied on said push and pull element (13, 14);

the amplifier (2, 6) amplifies the signals in accordance with an amplification factor (KI, KD) as a function of the weight of the device (12) and supplies the electric motor in order that it propel the drive wheel (5, 8) in accordance with a torque corresponding to the movement ordered by the sensor means (1, 1a, 5, 5a);

the sensor means (1, 1a, 5, 5a) which control each electric motor (3, 7) being capable of being operated separately in such a way that each drive wheel (5, 8) is powered selectively.

2. System in accordance with claim 1, characterised

because it has at least a first and a second electric motor (3, 8) as well as first independent means of control for the first electric motor (3) and a second independent means of control for the second electric motor (7), the first means of control consisting of first: sensor means (1, 1a) required by a first push and pull element (13), and secondly: the control means consisting of second sensor means (5, 5a) required by a second push and pull element (14).

3. System in accordance with claim 1 or 2, characterised because each one of the control means consists also of a first preamplifier means (11) which amplifies the electrical signals produced by the sensor means (1, 1a, 5, 5a) as a function of the pushing or pulling force detected (+FI, -FI, +FD, -FD), which applies preamplified signals to the power amplifier (2, 6) which feeds the drive wheel.

4. System in accordance with claim 1, 2 or 3, characterised because each one of the control means consists of in addition for each power amplifier (2, 6), a feedback circuit (5, 9) which compares, by means of a comparator means, the true value of the electric power fed to the electric motor with the pre-established nominal value of the electric power needed to achieve movement of the drive wheel, and transforms differences detected between the true value and the pre-established value into error signals (+II, -II, +ID, -ID) by means of which the electrical input signals to the power amplifier are altered in order that the latter supply the necessary power (+KFI, -KFI, +KFD, -KFD) to the electric motor (3, 7) in order that it can rotate on

basis of the torque needed to produce the movement ordered by the sensor means (1, 1a, 5, 5a).

5 5. System in accordance with claim 4, characterised because the feedback circuit (5, 9) consists of a second preamplifier means (10) which amplifies the error signals (+II, -II).

10 6. A system in accordance with claim 2, characterised because the first and the second push and pull element (13, 14) which are connected to the first and second force sensors (1, 1a, 5, 5a), are coupled to each other through a connecting element (17), said coupling being in such a manner that the
15 pulling or pushing of the connecting element (17) by the user can act selectively on the first (13) or the second (14) push element.

20 7. System in accordance with claim 6, characterised because the first and second push or pull elements (13, 14) connected to the first and second force sensors (1, 1a, 5, 5a), and the connecting element (17), configure an assembly formed by a handle.

25 8. System in accordance with claim 6 or 7, characterised because the push or pull elements (13, 14) are formed by bands whose first extremities are coupled to the connecting element (17) and whose second extremities are held immobile in fasteners
30 (15, 16), and because the first and second force sensors (1, 1a, 5, 5a) are extension-measuring gauges (1a, 5a) arranged on the bands (13, 14) in such a manner that when the connecting element is pushed or pulled, a deformation arises in the
35 corresponding band (13, 14), said extension being

detected by the pertinent gauge (1a, 5a).

5 9. System in accordance with any one of the previous
 claims, characterised because it is incorporated in
 a mobile X-ray unit.

10 10. System in accordance with claim 1, characterised
 because the amplification factor (K) is established
 as a function of the weight of the device (12)
 propelled and the application of a reasonable force
 to the push and pull elements (13, 14) by the user.

A B S T R A C T

**SYSTEM FOR THE CONTROLLED OPERATION OF A DEVICE
DRIVEN BY ELECTRIC MOTOR**

5 A system is described for the controlled propulsion
of a transporting device which consists of at least two
drive wheels propelled by electromotive means, in which
system at least two drive wheels are each propelled by
independent electric motors; each electric motor receives
10 electric power through an independent power amplifier
which amplifies electrical signals produced by sensor
means; the sensor means detect a mechanical force applied
on a push and pull element, and convert said mechanical
force into electrical signals which indicate the degree
15 and the direction of the mechanical force applied on said
push and pull element; and the amplifier amplifies the
signal in accordance with a factor which is a function of
the weight that the trolley has to move and it feeds the
electric motor so it can power the drive motor in
20 accordance with a torque corresponding to the movement
ordered through the sensor means.